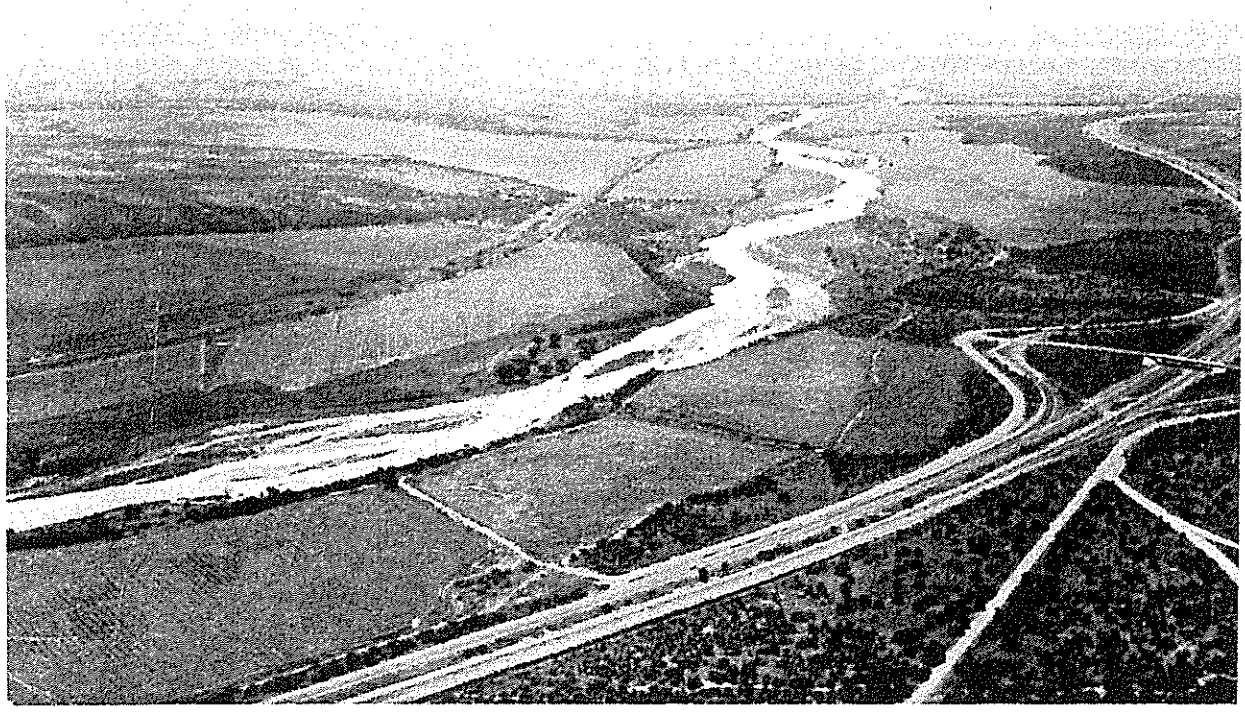
HAZARD INFORMATION

SANTA CRUZ RIVER

VICINITY OF SONOITA CREEK CONFLUENCE

SANTA CRUZ COUNTY

ARIZONA



PREPARED FOR
SANTA CRUZ COUNTY
BY
CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA
NOVEMBER 1969

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Aerial view of the Santa Cruz River near its confluence with Sonoita Creek. View is taken looking upstream. (Courtesy of Gulf American Corporation)

INTRODUCTION

This report relates to the potential flood hazards along a 12.0-mile reach of the Santa Cruz River in Santa Cruz County, Arizona. It was prepared at the request of the county to aid them in planning the best use of the land subject to overflow.

The nature and effect of two probable future floods, namely, the Intermediate Regional and Standard Project Floods, are considered in this report. An Intermediate Regional Flood is a flood that has an average frequency of occurrence of once in 100 years, although this flood may occur in any year. A Standard Project Flood is a flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations.

The report, which is based on the topographic conditions existing as of December 1968, contains maps, profiles, and cross sections, which indicate the extent and depth of flooding that might occur in the future along the study reach of the Santa Cruz River. With this information and through "flood plain management," the county can guide development of the flood plain. This approach involves the application of control through planned development and management over the use of lands susceptible to floods. This prevention of local flood damage would be an essential part of the community planning and development. It means giving consideration to zoning and subdivision regulations, land acquisition for parks and open spaces, special planning of streets and utilities, and appropriate construction standards for buildings in flood hazard areas, as well as to levees, dams, and other protective works.

GENERAL DESCRIPTION OF PROBLEM AREA

The reach of the Santa Cruz River studied extends from river mile 169.0 near the Tumacacori National Monument to river mile 181.0 upstream from Sonoita Creek confluence (see pl. 1). The river flows generally northward in the reach considered. U.S. Highway 89 parallels the river on the west side and the Southern Pacific railroad parallels it on the east side. The river flows through a relatively narrow valley, part of which is used for agriculture and part for cattle grazing.

Most of the land adjoining the river is within the Gulf American Corporation of Arizona Rio Rico project area, which consists of about 55,000 acres that are being subdivided for residential type developments. As the area is developed, it can be expected that it will become highly urbanized.

The drainage area of the Santa Cruz River above the downstream limit of this study is 1,170 square miles, part of which is in Mexico. Major tributary streams within the study reach are Sonoita Creek, Potrero Creek, Josephine Canyon, Peck Canyon, and Agua Fria Canyon.

Existing flood control facilities

There are no existing flood control facilities in the study reach of the Santa Cruz River, nor are there county or Federal flood control projects authorized or proposed in the study area. Local interests have constructed post and wire fences along intermittent reaches of the river for the protection of the river banks; otherwise, the river has remained in its natural state. There is a dam forming a lake for recreational purposes on Sonoita Creek, located about 5 miles upstream from its confluence with the Santa Cruz River. It is assumed that the reservoir would be full to spillway crest during the occurrence of the Intermediate Regional and Standard Project Floods in Sonoita Creek; therefore, the dam would have no effect in

reducing the magnitude of floods flowing into the Santa Cruz River from Sonoita Creek.

A survey for flood control and allied purposes of the Santa Cruz River Basin is presently being conducted by the Corps of Engineers concurrently with the U.S. Bureau of Reclamation. The Bureau will consider multipurpose dams on the Santa Cruz River. In addition to multipurpose dams, the Corps will consider detention dams, check dams, and channel improvements on the Santa Cruz River and its tributaries.

Bridges across the stream

One local road bridge (mile 176.36) and one railroad bridge (mile 177.89) cross the Santa Cruz River in the reach studied. The local road bridge (fig. 1), which is the Rio Rico Drive bridge, is a four-span concrete bridge, having a total length of about 265 feet. The approaches to the bridge are at lower elevations than the floor elevation of the bridge.

The railroad bridge (fig. 2), which is located at the confluence of Sonoita Creek with the Santa Cruz River, is a 14-span wooden bridge, having a total length of about 280 feet. The railroad diverges from along the river toward Nogales at this point. The bridge and its piers are on a skew; and consequently, they would be an obstruction to floodflows in the river. The probability exists that sections of the bridge would be washed out during the Intermediate Regional and Standard Project Floods in the Santa Cruz River.

Rainfall and past floods

Three types of storms (general winter storms, general summer storms, and local thunderstorms) produce precipitation in the Santa Cruz River drainage area. General winter storms are usually of North Pacific Ocean origin, moving inland to southern California, Arizona, and New Mexico. Precipitation during general winter storms

BRIDGES ACROSS THE SANTA CRUZ RIVER

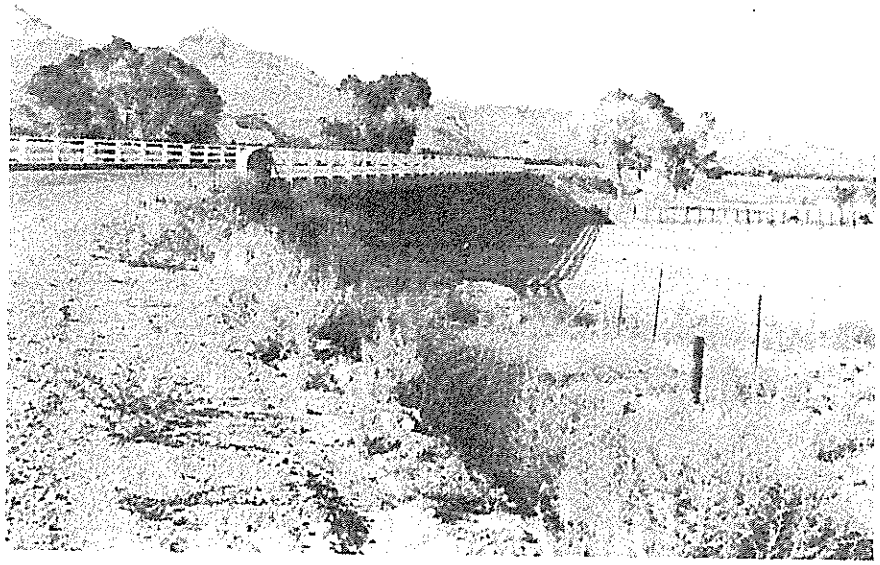


Figure 1.--Upstream side of Rio Rico Drive bridge at mile 176.36, downstream from the railroad bridge in figure 2.

Figure 2.--Upstream side of Southern Pacific railroad bridge at mile 177.89, at the confluence of the Santa Cruz River with Sonoita Creek.

(R) may be continuous for several days. General summer storms usually result from an influx of tropical maritime air originating over the Gulf of Mexico or over the South Pacific. Such storms occur generally between the months of July and September, causing heavy rainfall over large areas for periods up to 24 hours.

General summer storms and floods of very high magnitude have occurred in hydrologically similar basins. These resulted from the (R) chance centering of summer storms over nearby drainage areas, such as the following: San Pedro River at Charleston (1,220 sq. miles), a peak discharge of 98,000 cubic feet per second on September 28, 1926; and on Santa Rosa Wash at Vaiva Vo (1,780 sq. miles), a peak of 53,000 cubic feet per second on September 27, 1962. Such high magnitude peaks are entirely possible in the Santa Cruz River Basin if a similar type summer storm should center over the drainage area.

Local thunderstorms, which are frequent summer phenomena, may occur separately or in conjunction with general storms. Such storms cover comparatively small areas and result in high-intensity rainfall of short duration, usually 3 hours or less.

Records of stream-gaging stations on the Santa Cruz River indicate that large floods occurred in 1914, 1935, 1946, 1950, 1955, 1962, 1964, and 1967. Data from four active gaging stations are available from which it is possible to develop a history of past floods in the study reach of the river and to predict the magnitude and frequency of future floods. These stations are as follows:

Santa Cruz River near Lochiel
Santa Cruz River near Nogales
Sonoita Creek near Patagonia
Santa Cruz River at Continental

In addition, records are available for Nogales Wash from a stream-gaging station that existed during the period between April 1932 and February 1934. The highest recorded peak discharges for these stations are shown in table 1.

(R) REVISED 25 MARCH 1970

Table 1

PAST FLOODS

Station	Date	Highest recorded peak discharge cfs	Drainage area sq. mi.
Santa Cruz, Lochiel (1949-date)	9-12-65	4,810	82
Santa Cruz, Nogales (1907-date)	12-20-67	15,200	533
Sonoita, Patagonia (1930-33, 1935-date)	9-30-46	14,000	210
Santa Cruz, Continental (1940-46, 1951-date)	12-20-67	18,000	1,662
Nogales Wash, Nogales (1932-34)	8-26-32	3,250	37

A flood damage investigation made by the Corps of Engineers of the 1962 storm and flood in the Santa Cruz River indicated that extensive bank erosion and flooding of low lying pasture and cropland resulted. Total damage along the Santa Cruz River in Santa Cruz County was estimated to be $95,000 (1962 price levels). Extremely high runoff from local tributaries, such as Sonoita Creek and Josephine Canyon, flooded the entire width of the valley floor. This flood had a recorded peak discharge of about 2,020 cubic feet per second at the stream-gaging station at Nogales and a peak discharge of about 2,480 cubic feet per second at the stream-gaging station at Continental.

Aerial photographs of the December 1967 flood in the Santa Cruz River indicate that an extensive area of the valley floor was inundated and a section of U.S. Highway 89 was damaged by erosion of its embankment. This flood had a peak discharge of about 15,200 cubic feet per second at the stream-gaging station at Nogales and a recorded peak discharge of 18,000 cubic feet per second at the stream-gaging station at Continental. Figures 3 and 4 show the damage and the area inundated by this flood in the Santa Cruz River in the reach studied.

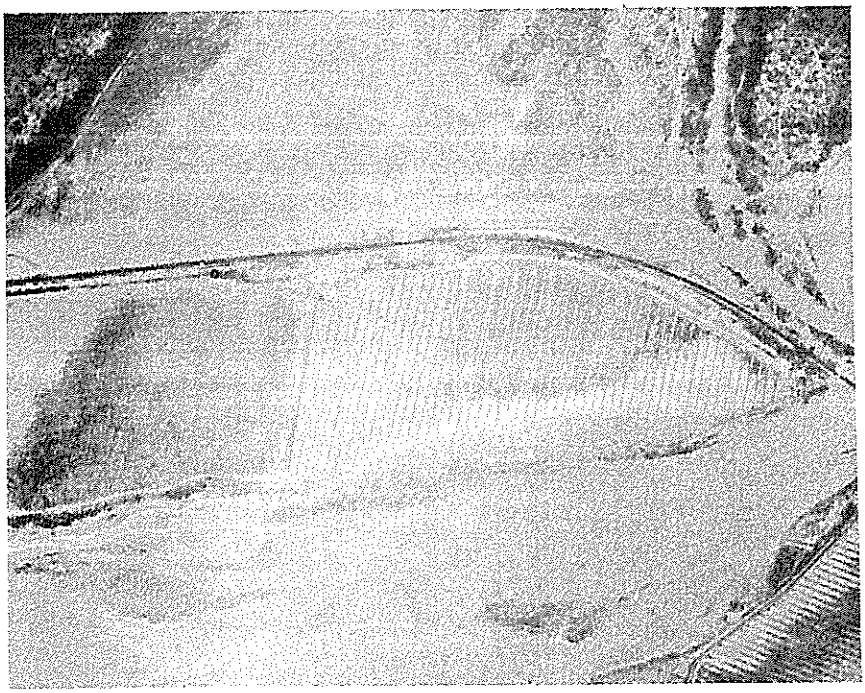


Figure 3.--Aerial view of the Santa Cruz River during the 1967 flood. The area shown is just downstream from the Southern Pacific railroad bridge.

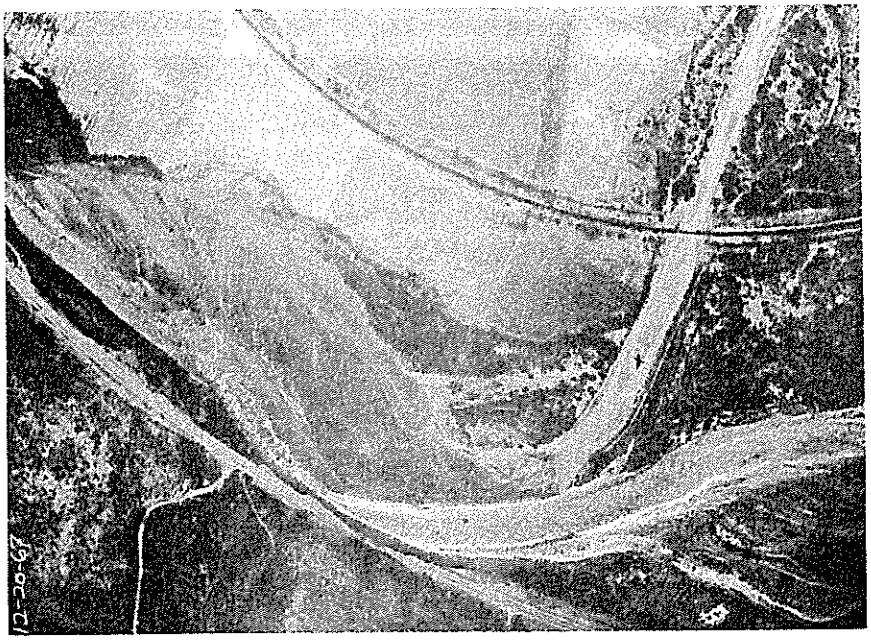


Figure 4.--Aerial view of the Santa Cruz River at the confluence with Josephine Canyon during the 1967 flood. Photo shows the damage to U.S. Highway 89.

PROBLEMS OF FUTURE FLOODS

Floods of appreciable magnitudes have been experienced in the past on the Santa Cruz River and on its tributaries; and the probability exists that larger floods of the magnitudes considered here, namely, the Intermediate Regional and Standard Project Floods, would occur in this river. Floods the size of the Intermediate Regional Flood represent floods that may reasonably be expected to occur more frequently, although they will not be as large as the infrequent Standard Project Flood. Floods the size of the Standard Project Flood represent reasonably upper limits of expected flooding. Peak discharges of the Intermediate Regional Flood and of the Standard Project Flood are shown on table 2, on the following page, for several points along the Santa Cruz River, and one point each on Sonoita Creek and on Josephine Canyon, tributaries to the Santa Cruz River.

Table 2

PEAK DISCHARGES

Stream and location	River mile	Drainage area	Intermediate Regional Flood discharge cfs	Standard Project Flood discharge cfs
Santa Cruz River				
Downstream limit of study	169.00	1,170	56,000	88,000
Downstream from confluence with Josephine Canyon	169.88	1,120	55,000	85,000
Rio Rico Drive bridge	176.36	974	54,000	80,000
Upstream from confluence with Sonoita Creek	178.00	722	51,000	68,000
Upstream limit of study	181.00	610	48,000	65,000
Sonoita Creek				
Confluence with Santa Cruz River	0.00	264	*28,000	*70,000
Josephine Canyon				
Confluence with Santa Cruz River	0.00	51	*13,500	*43,000

*Based on assumed occurrence of a local thunderstorm.

Areas flooded and heights of flooding

Plate 2 is an index map of plates 3 through 14, which show the areas along the Santa Cruz River that would be flooded by the Intermediate Regional and Standard Project Floods. The actual limits of these overflow areas on the ground may vary somewhat from those shown on the map because the small scale of the map does not permit precise plotting of the flooded area boundaries. Depths of flow in the Santa Cruz River can be estimated from the high water profiles that are shown on plates 15 through 18 and from the cross sections that are shown on plates 19 and 20. As shown, the Standard Project Flood profile is generally about 2 feet higher than that of the Intermediate Regional Flood. The water surface profile computations were based on the topographic maps dated December 1968, which were provided by the Cella and Barr Engineering Company of Tucson, Arizona, and supplemented with information obtained during field investigations of the stream.

Structures affecting the flow

The railroad bridge and the local road bridge, which cross the river in the study reach, would significantly affect the flow in the river. These two bridges would not have openings that would be adequate to pass the Intermediate Regional Flood or the Standard Project Flood, if these two floods were contained within the channel section of the river and were made to flow through the bridges.

In addition to the two bridges, the railroad embankment, which is in the flood plain of the Santa Cruz River, would significantly affect the flow in the river. In reaches where the railroad embankment would be above the flood stage of the Intermediate Regional and Standard Project Floods in the river, the flow on the east (opposite) side of the railroad embankment would be at a lower stage than the flood stage on the river side of the embankment. In reaches where the railroad embankment would be inundated, the flood stage on both sides of the embankment would be about the same. The cross sections,

plates 19 and 20, show the effects of the railroad embankment, as described above. There are culverts and bridges through the railroad embankment at intermittent points along the railroad; however, they would have little or no effect on the flow during the occurrence of the Intermediate Regional and Standard Project Floods in the Santa Cruz River.

Velocity of water

The velocity of water in the channel of the Santa Cruz River in the study reach for the Intermediate Regional and Standard Project Floods would generally range from 5 to 11 feet per second. These velocities would cause a significant amount of bank cutting and scour to the riverbed. The velocity of water on the flood plain outside the channel would generally range from 3 to 6 feet per second. These velocities would cause the deposition of silt and debris on the overbank areas along the river.

Table 3 lists the velocity of water that would occur in the channel and on the overbank areas at selected points along the river during the Intermediate Regional and Standard Project Floods. They are indicative of the type of velocities that would occur in the study reach of the Santa Cruz River.

Velocities greater than 3 feet per second, combined with depths of 3 feet or greater, are considered hazardous to life and property.

Table 3

VELOCITY OF WATER

Stream	Location mile	Intermediate Regional Flood velocity Channel fps	Intermediate Regional Flood velocity Overbank fps	Standard Project Flood velocity Channel fps	Standard Project Flood velocity Overbank fps
Santa Cruz River					
Near downstream of study	169.3	7	3	9	4
Upstream from Otero	172.2	5	3	5	3
One mile downstream from Rio Rico Drive	175.3	8	3	9	4
Near confluence with Sonoita Creek	177.3	7	4	8	4
Upstream from confluence with Potrero Creek	179.0	9	5	11	6
Upstream limit of study	181.0	7	5	7	5

GLOSSARY OF TERMS

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or a stream, an ocean, or a lake or other body of standing water.

Normally, a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or low lands adjoining the channel of a river, a stream, or a watercourse, an ocean, or a lake or other body of standing water, which has been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years, although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

Low Steel (or Soffit). The lowest point of a bridge or other structure over or across a river, stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.

Probable Maximum Flood. The probable maximum flood represents a flood discharge that may be expected from the most severe combination of critical meteorological and hydrological conditions that is reasonably possible in the region. Such floods, as used by the Corps of Engineers, are applicable to projects, such as dams, where consideration is to be given to virtually complete security against potential floods.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40 percent to 60 percent of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

AUTHORITY, ACKNOWLEDGEMENTS, AND INTERPRETATION OF DATA

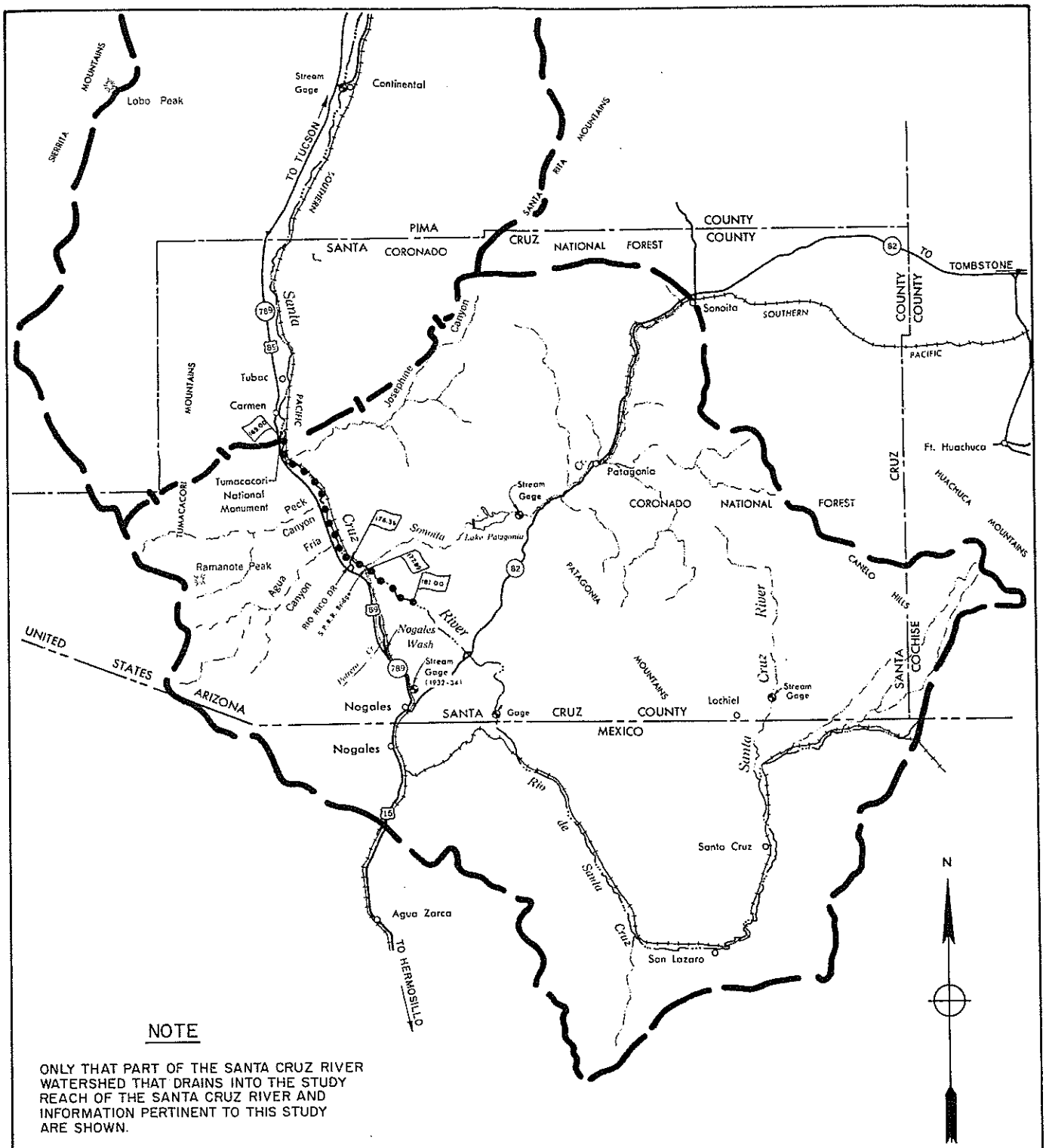
This report has been prepared in accordance with the authority granted by section 206 of the Flood Control Act of 1960 (Public Law 86-645), as amended.

* * *

Assistance and cooperation of Santa Cruz County, Cella and Barr Engineering Company, Gulf American Corporation of Arizona, and Southern Pacific railroad in supplying useful data are appreciated.

* * *

This report presents the potential flood hazard condition along the Santa Cruz River in Santa Cruz County. The Los Angeles District of the Corps of Engineers will, upon request, provide technical assistance in the interpretation and use of the information contained herein and will provide other available flood data related thereto.



NOTE

ONLY THAT PART OF THE SANTA CRUZ RIVER WATERSHED THAT DRAINS INTO THE STUDY REACH OF THE SANTA CRUZ RIVER AND INFORMATION PERTINENT TO THIS STUDY ARE SHOWN.

LEGEND

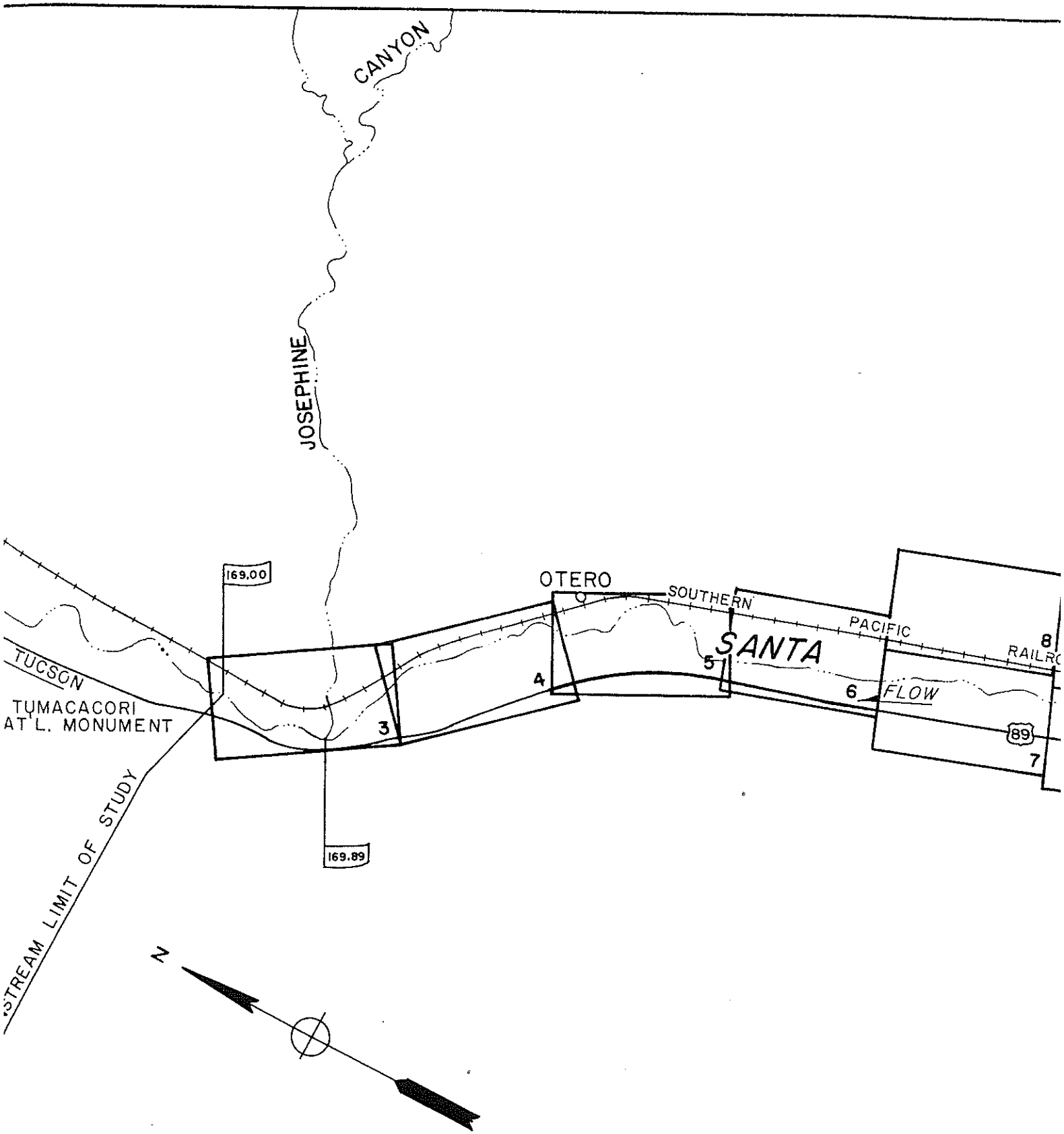
- REACH COVERED BY THIS REPORT
- BOUNDARY OF DRAINAGE AREA
- BOUNDARY OF SUBDRAINAGE AREA
- MILES ABOVE MOUTH

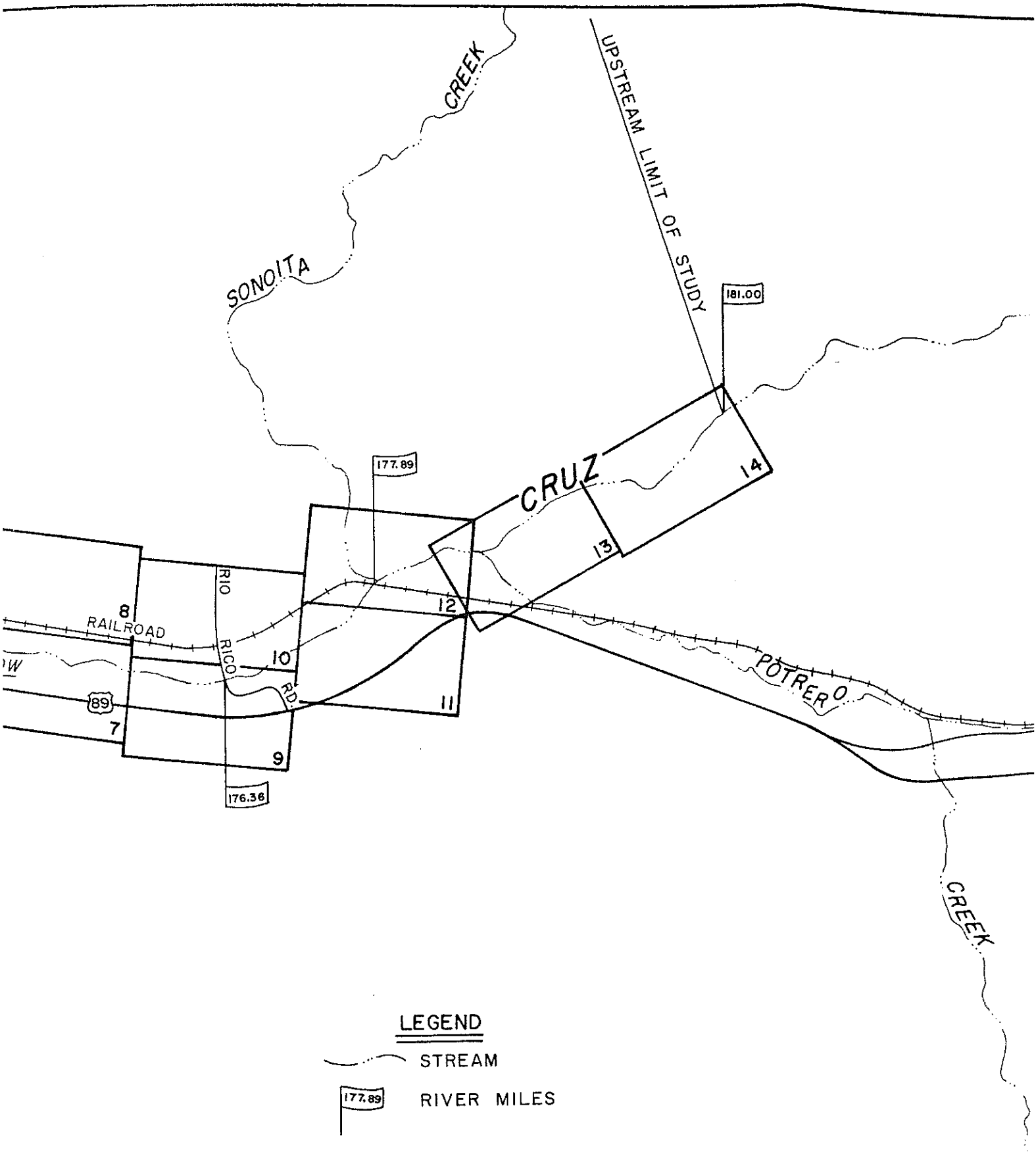
CORPS OF ENGINEERS, U.S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA

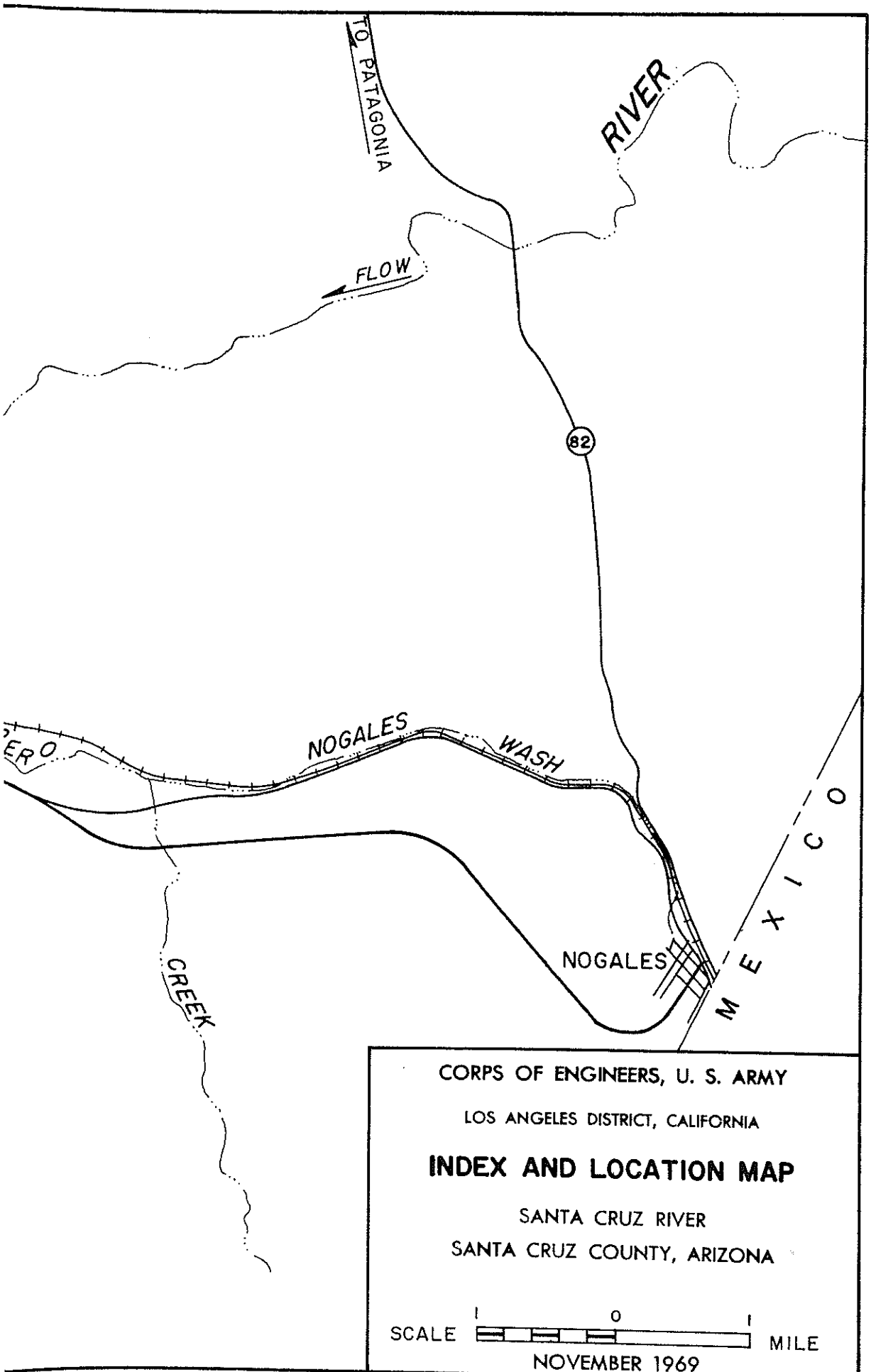
SANTA CRUZ RIVER WATERSHED

SCALE 5 0 5 10 MILES

NOVEMBER 1969


CANYON
JOSEPHINE
169.00
OTERO
SOUTHERN
PACIFIC
SANTA
FLOW
TUCSON
TUMACACORI
AT L. MONUMENT
3
4
5
6
7
8
89
169.89
STREAM LIMIT OF STUDY
N


SONOITA CREEK
UPSTREAM LIMIT OF STUDY
181.00
177.89
CRUZ
14
13
12
11
10
9
8
7
RIO RICO RD
RAILROAD
89
POTRERO
CREEK
176.36
LEGEND
STREAM
177.89
RIVER MILES



CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

INDEX AND LOCATION MAP

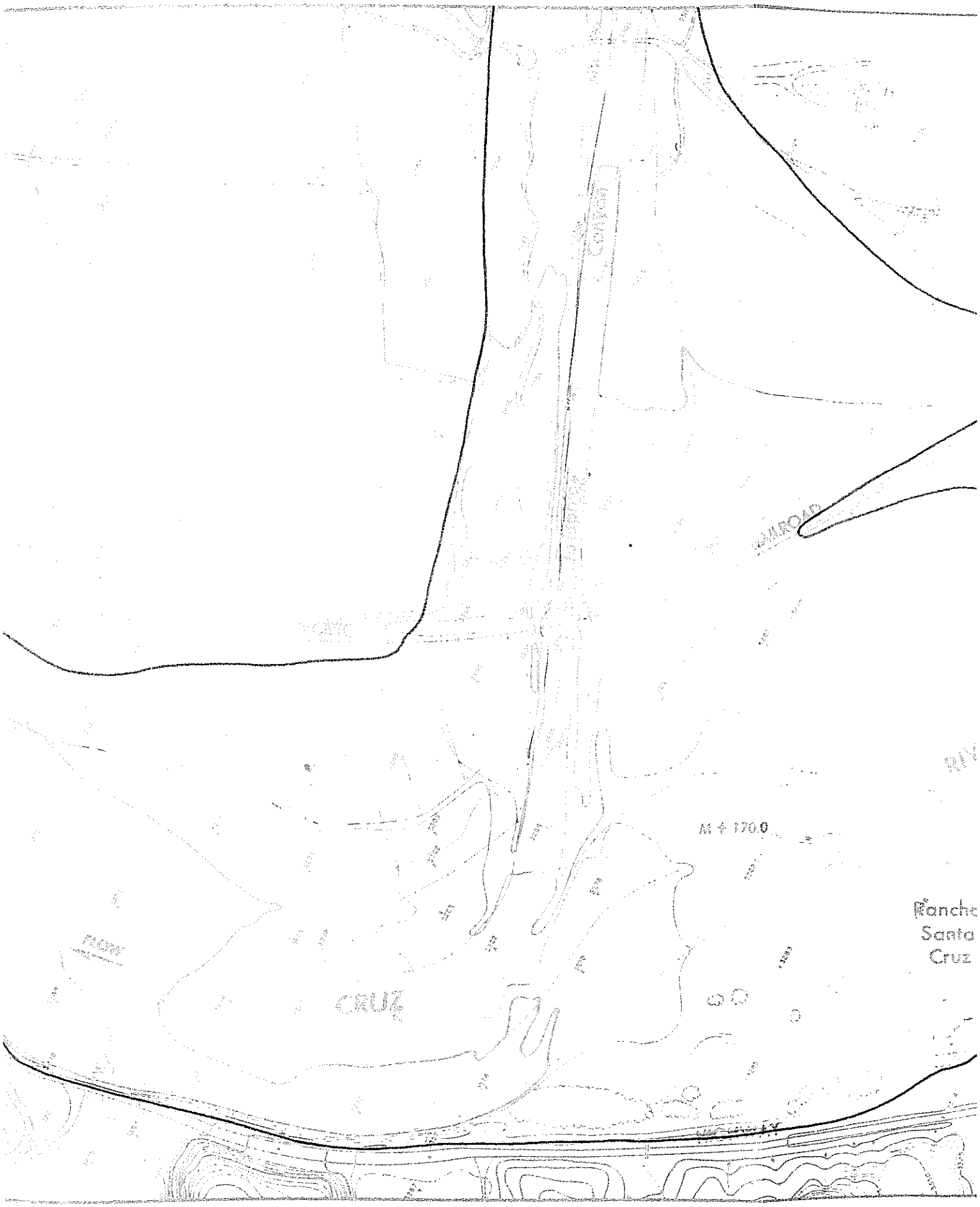
SANTA CRUZ RIVER

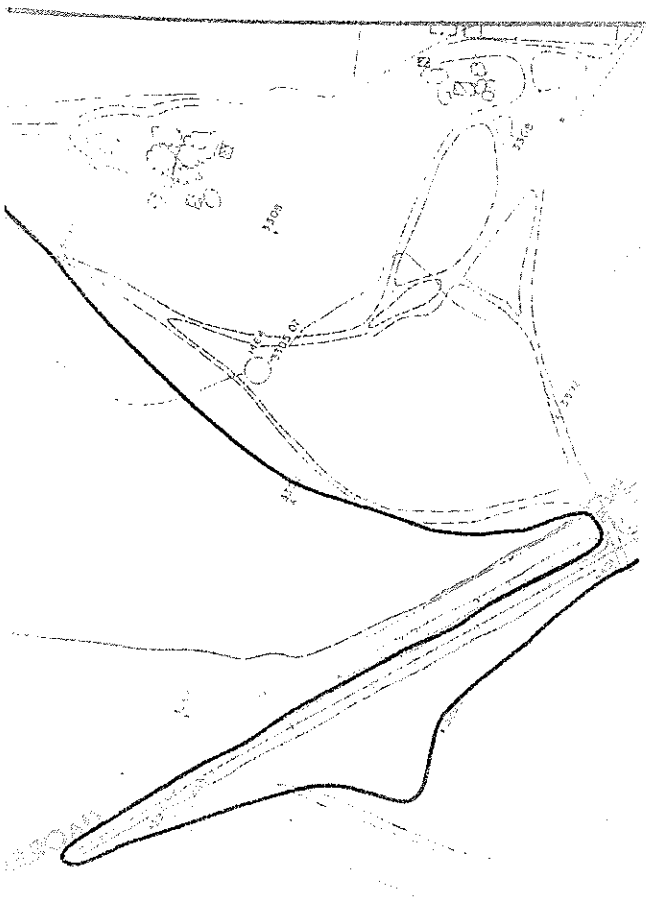
SANTA CRUZ COUNTY, ARIZONA

SCALE 1 0 1 MILE

NOVEMBER 1969

NOTE: FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT FLOOD OCCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER AND JOSEPHINE CANYON. AREAS ADJACENT TO THE MAIN STEM FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING COMMISSION OF SANTA CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.


M 170.0
Rancho
Santa
Cruz



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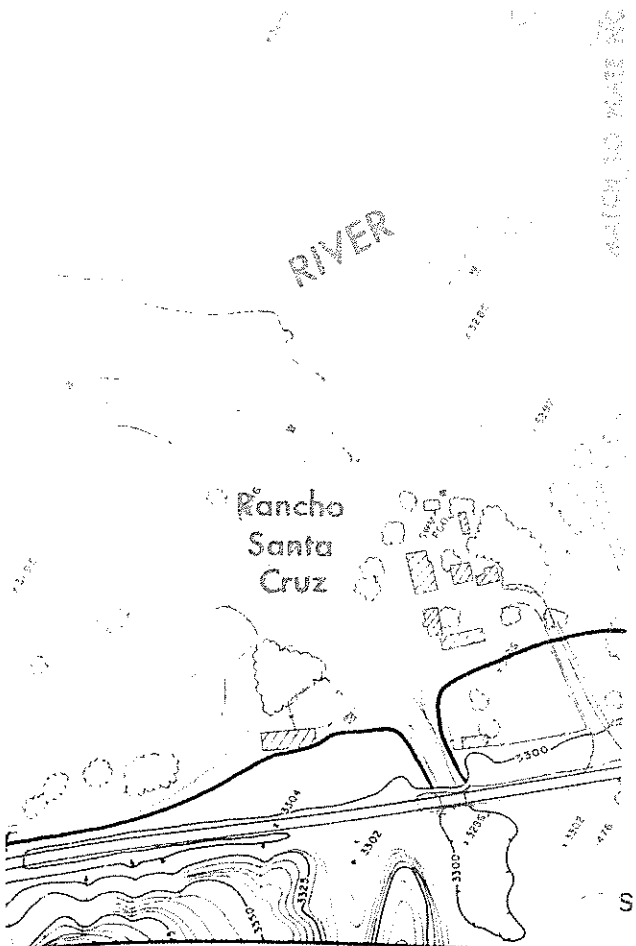


CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

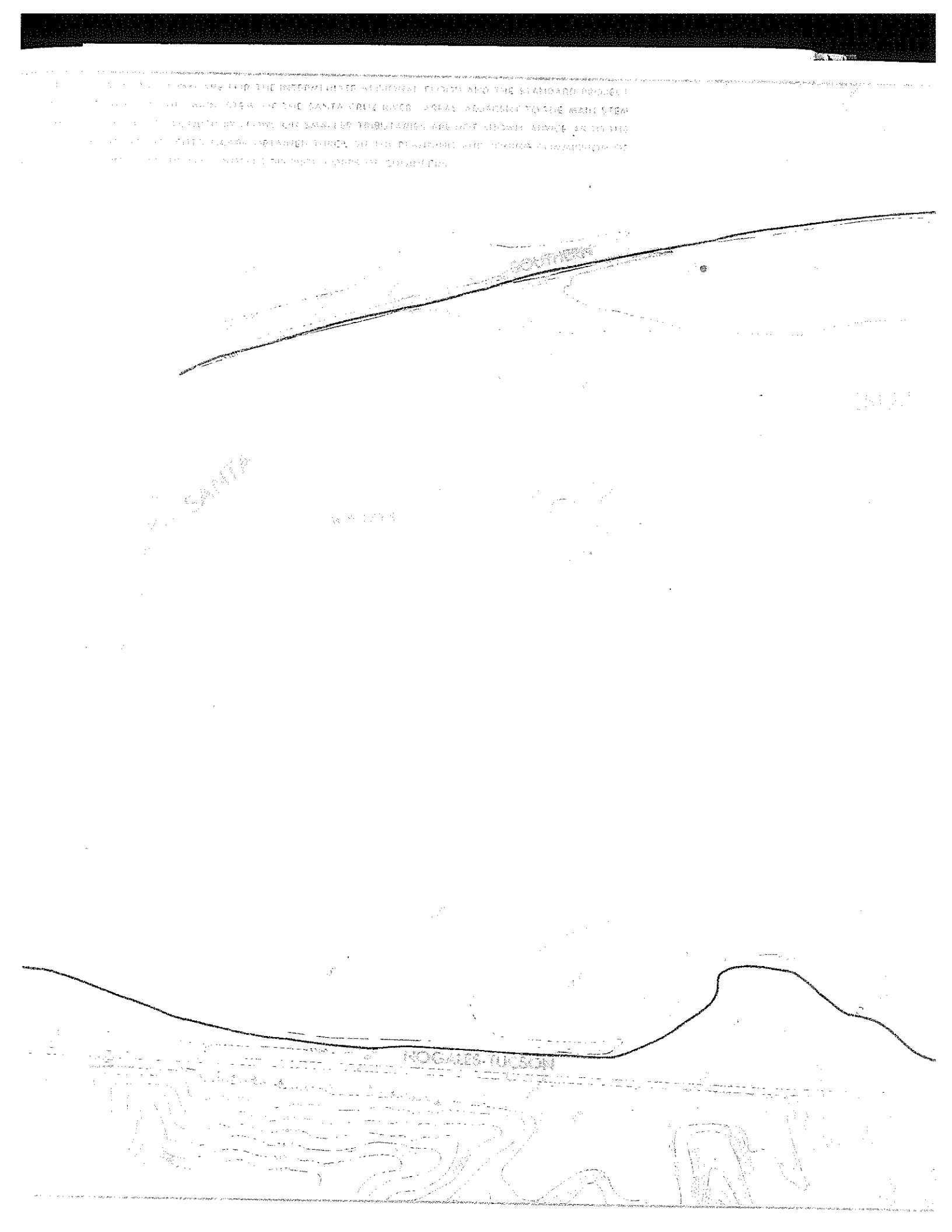
SANTA CRUZ COUNTY, ARIZONA

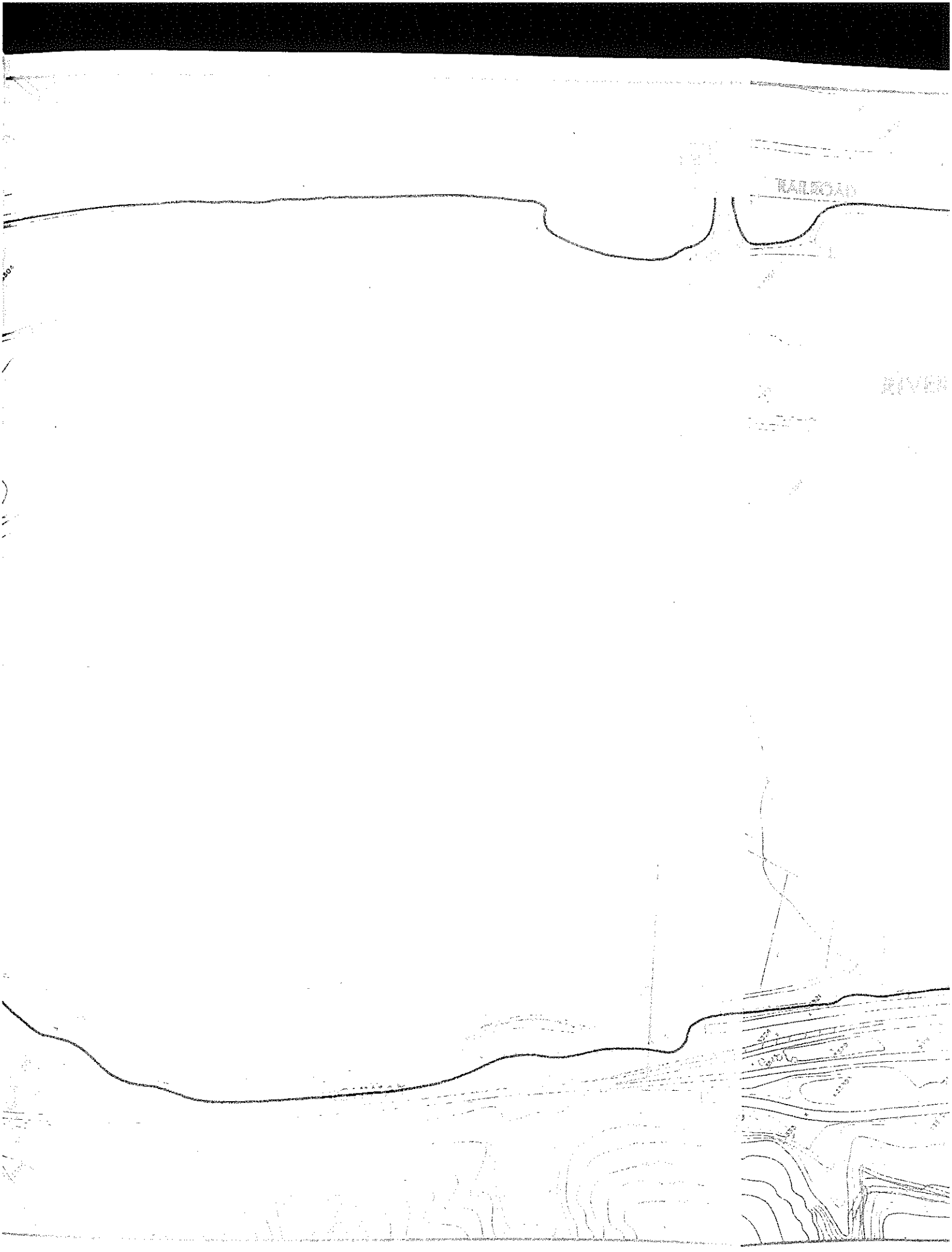
400 0 400

SCALE FEET

NOVEMBER 1969

PLATE 3


SOUTHERN
SANTA
ROGERS HUDSON



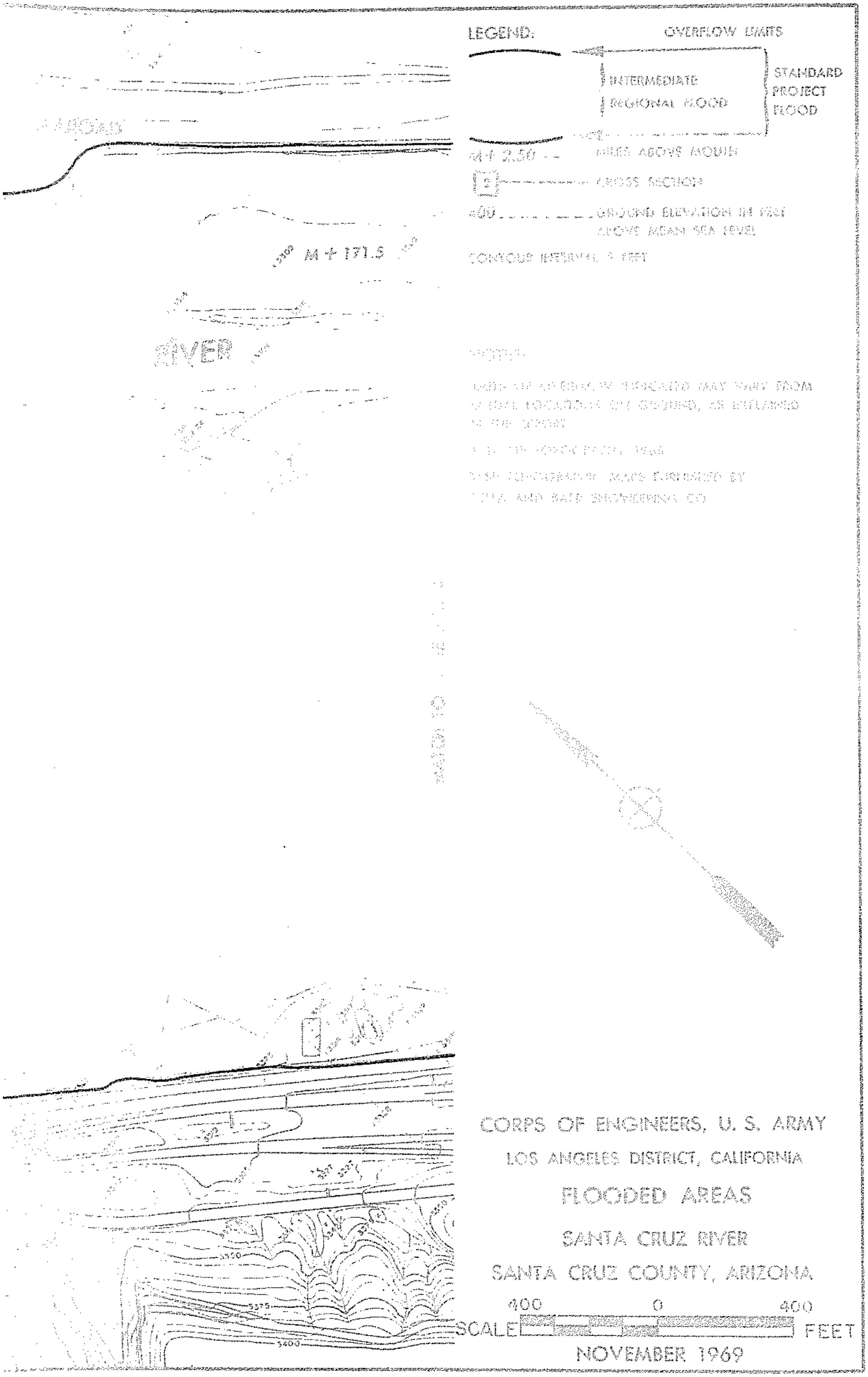
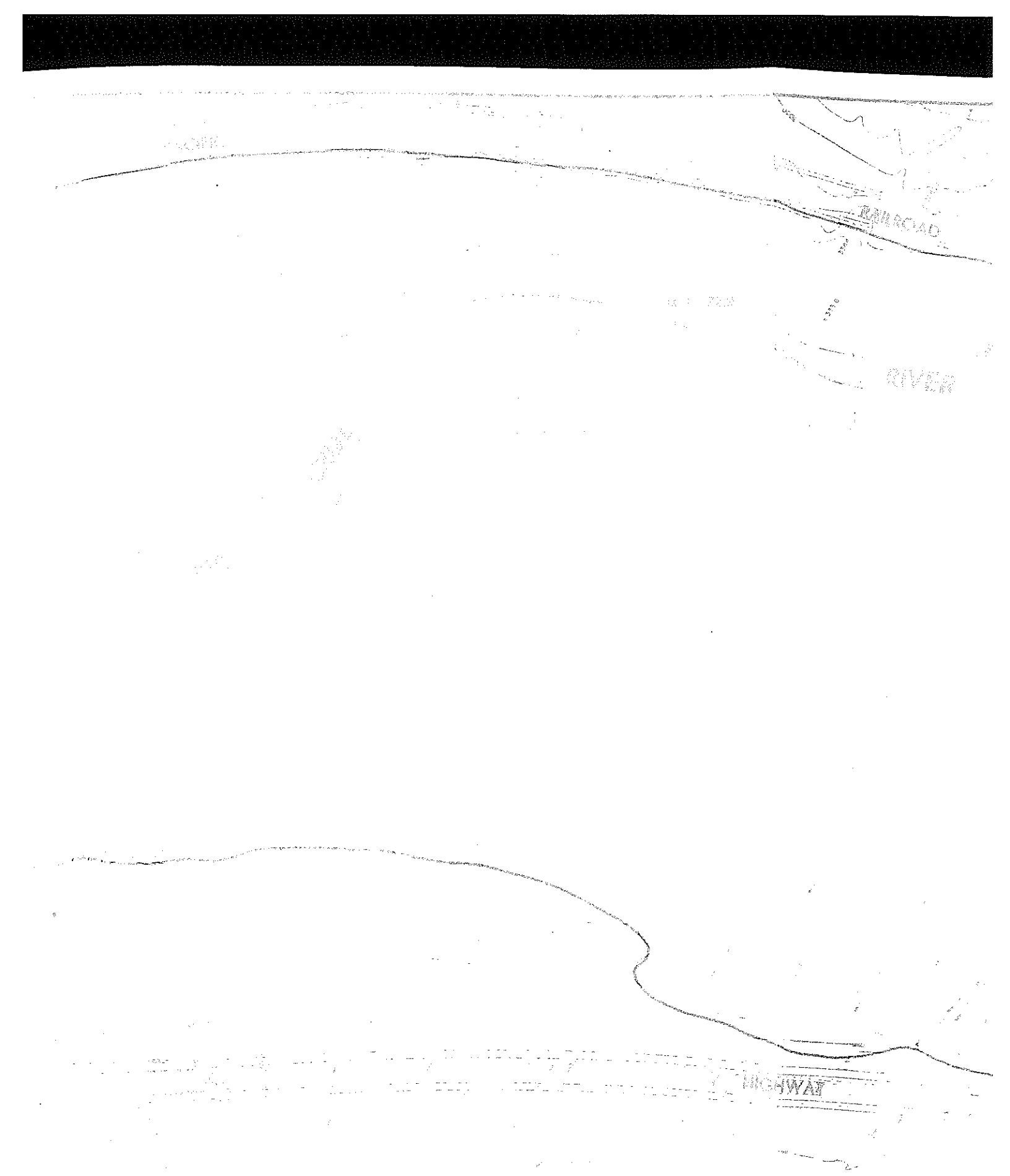
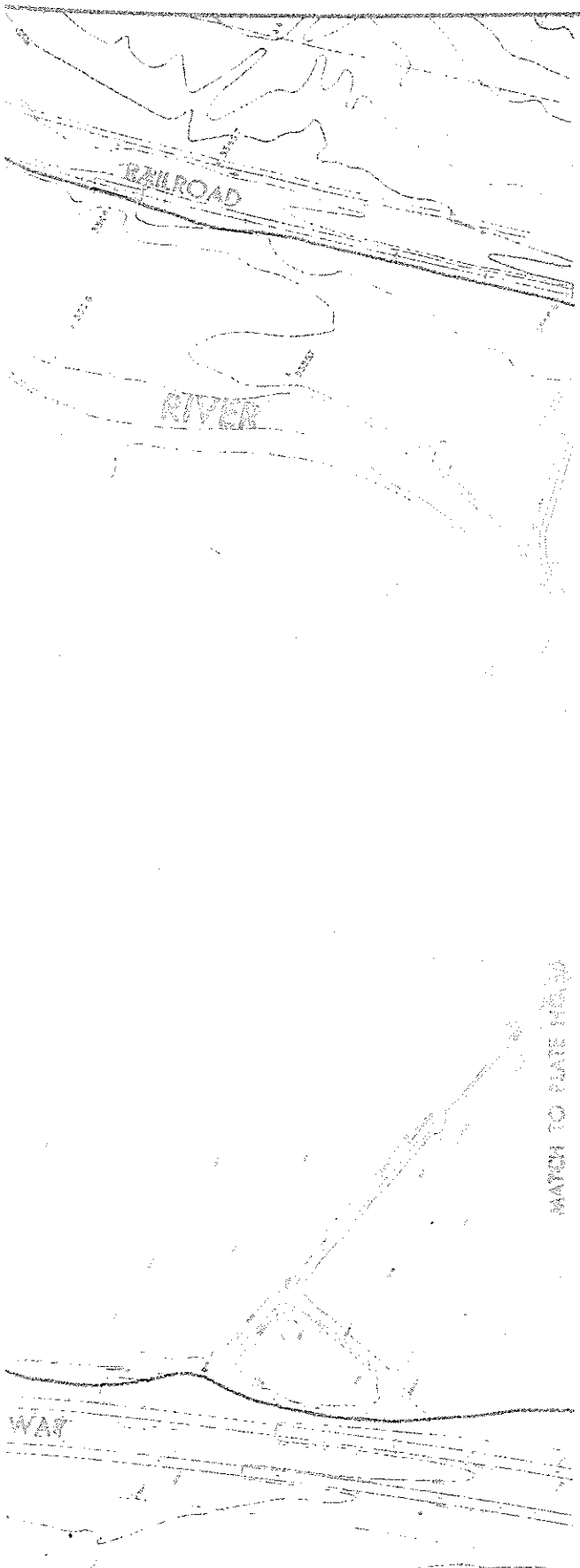

LEGEND:
OVERFLOW LIMITS
INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD
M + 2.50 MILES ABOVE MOUTH
2 CROSS SECTION
400 GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL
M + 171.5
RIVER
3550
3375
3400
CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA
FLOODED AREAS
SANTA CRUZ RIVER
SANTA CRUZ COUNTY, ARIZONA
400 0 400
SCALE FEET
NOVEMBER 1969

PLATE 4


SANTA
ROGALES-YUCATAN



NOTE: FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD A
FLOOD OCCURRING FOR THE MAIN STEM OF THE SANTA CRUZ RIVER. AREAS A
FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NO
FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AP
SANTA CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M 2.50 ..... MILES ABOVE MOUTH

3 ——— CROSS SECTION

400 ..... GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 2 & 5 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY 1968

BASE TOPOGRAPHIC MAPS FURNISHED BY ULTEA AND SAHR ENGINEERING CO.

. INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT
F THE SANTA CRUZ RIVER. AREAS ADJACENT TO THE MAIN STEM
S ON SMALLER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE
TAINED THROUGH THE PLANNING AND ZONING COMMISSION OF
DISTRICT, CORPS OF ENGINEERS.

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

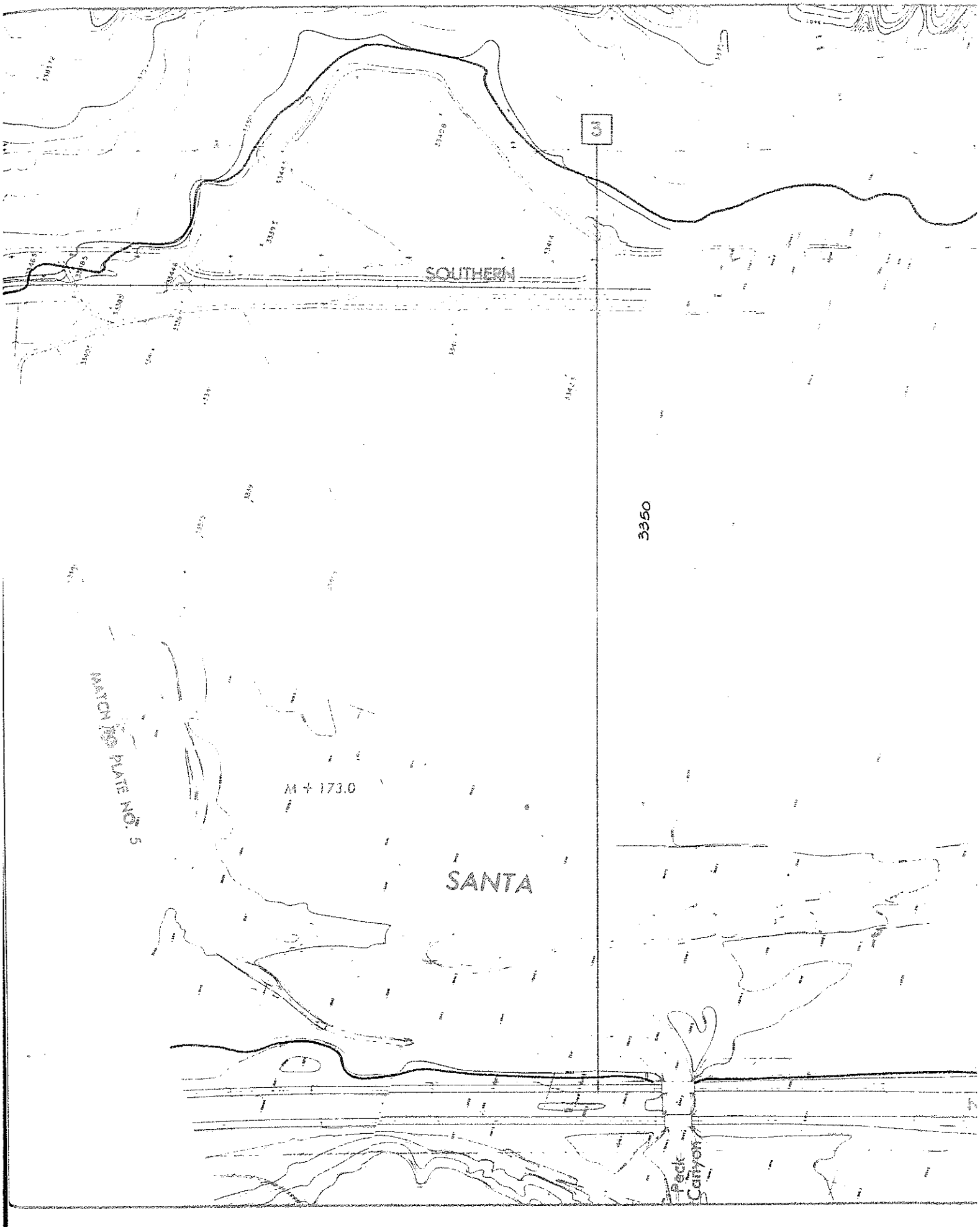
SANTA CRUZ COUNTY, ARIZONA

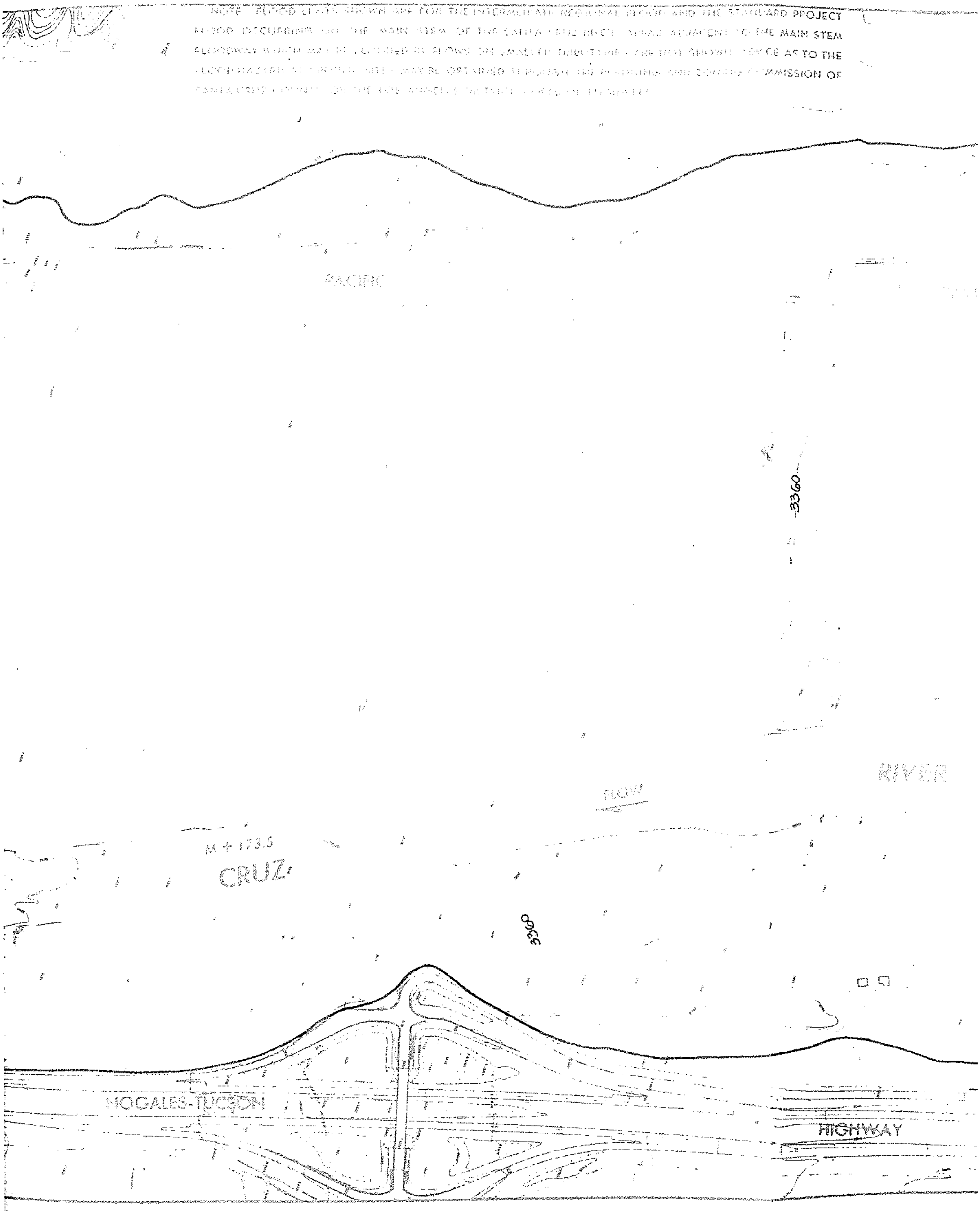
400 0 400

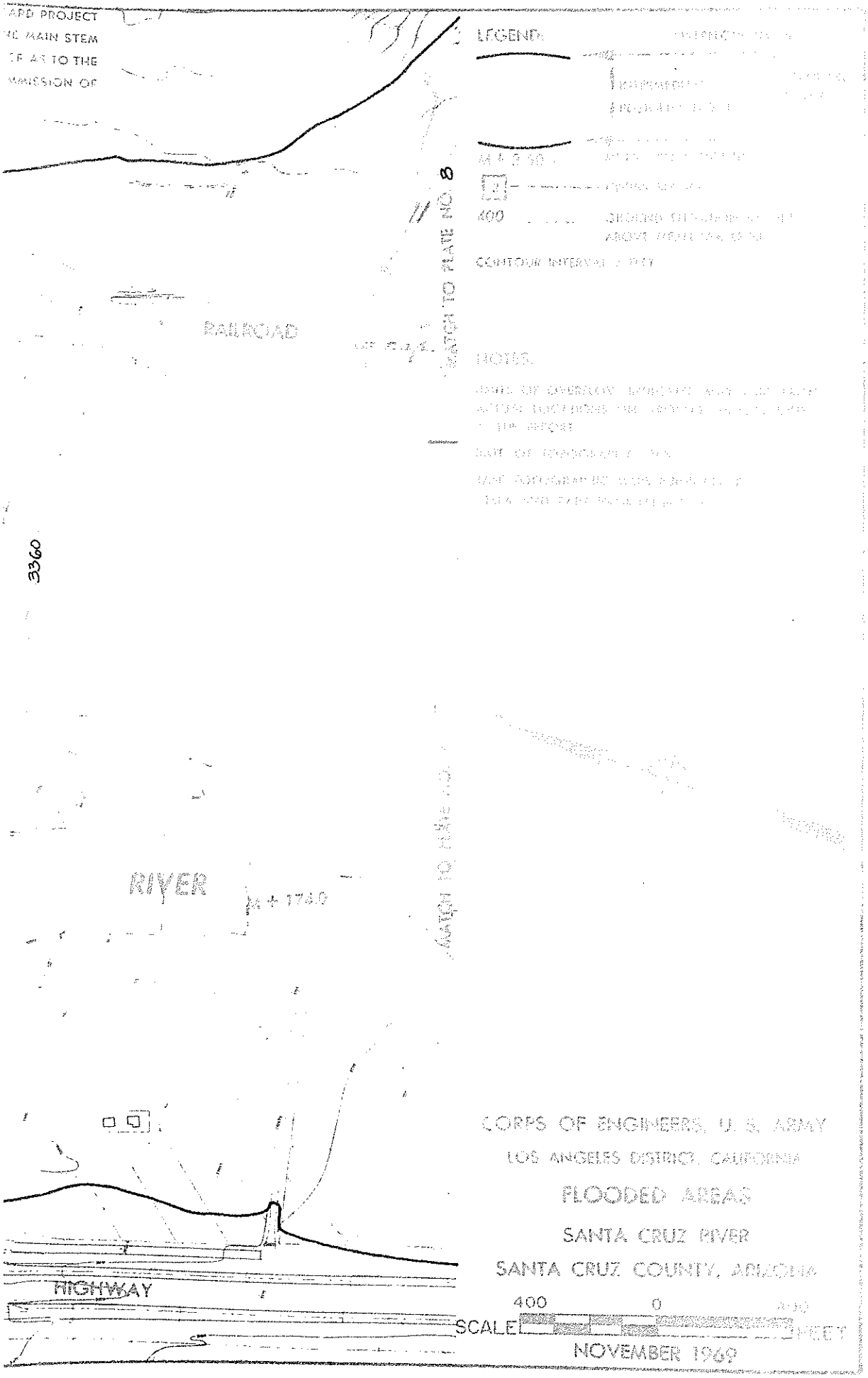
SCALE FEET

NOVEMBER 1969

PLATE 5


SOUTHERN
3350
MATCH LINE PLATE NO. 5
M + 173.0
SANTA
Peck Canyon


PACIFIC
3360
RIVER
FLOW
M + 173.5
CRUZ
3360
NOGALES-TUCSON
HIGHWAY



LEGEND:

NOTES:

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

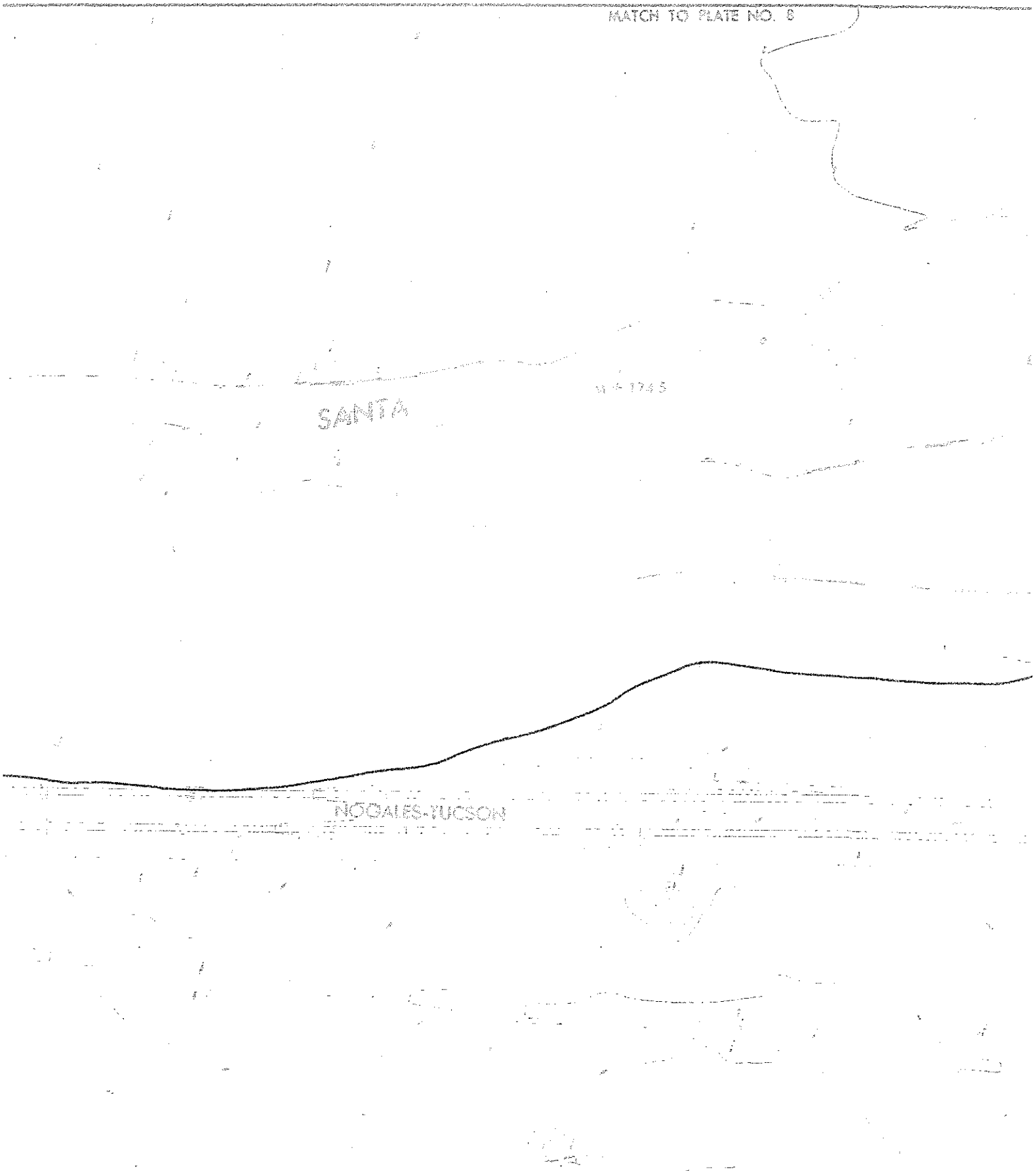
FLOODED AREAS

SANTA CRUZ RIVER

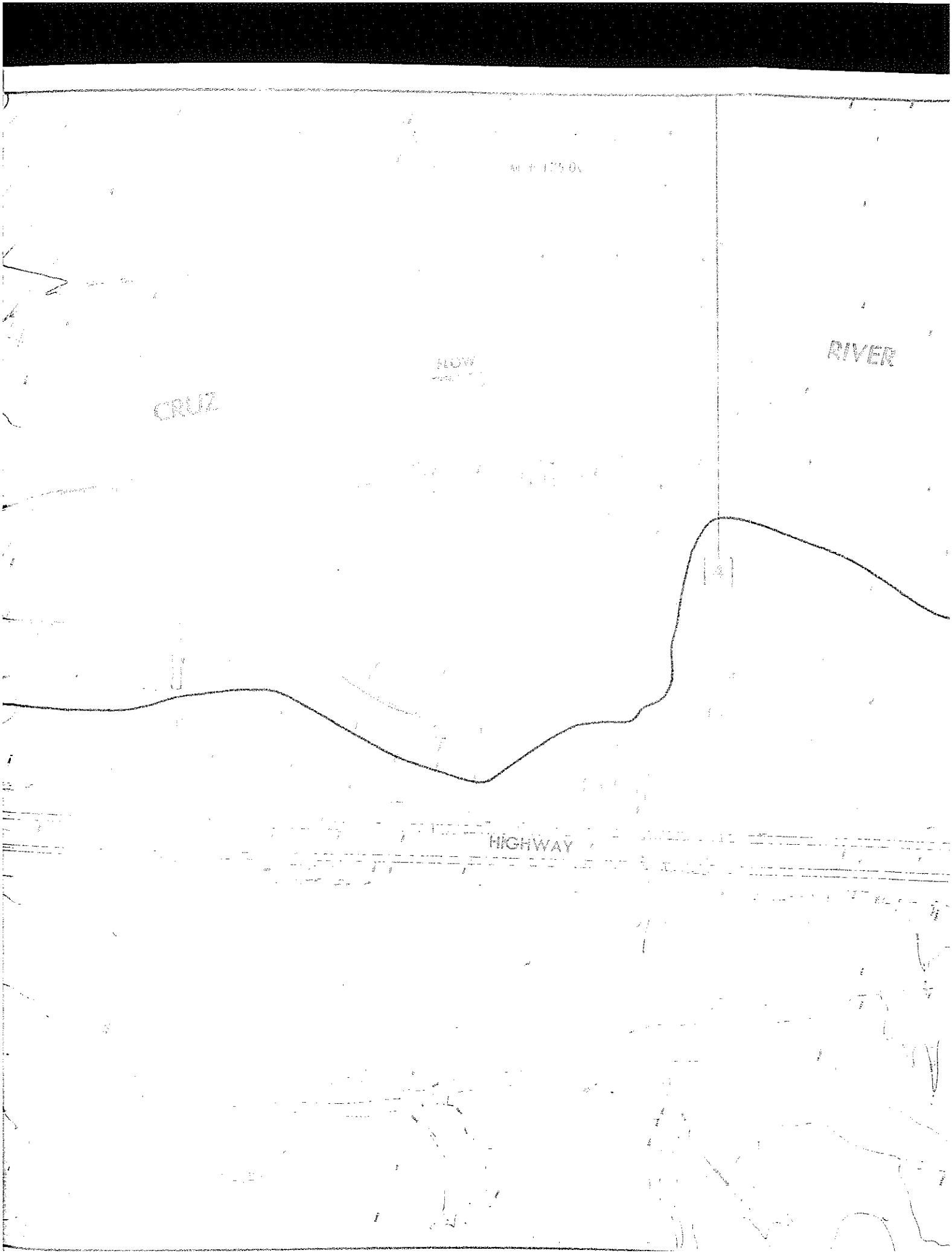
SANTA CRUZ COUNTY, ARIZONA

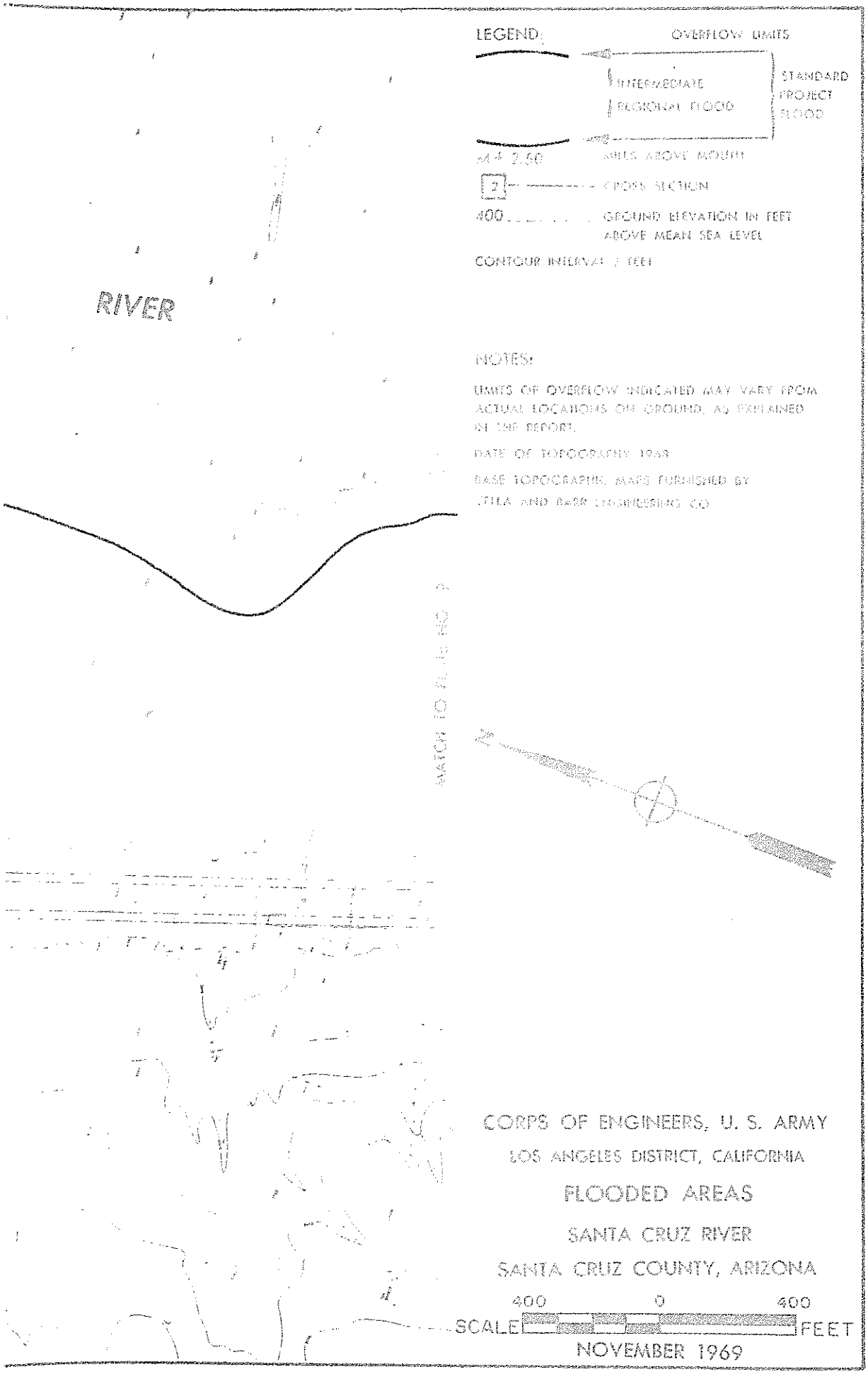
400 0 400

NOVEMBER 1969



FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT OCCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER. AREAS ADJACENT TO THE MAIN STEM MAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING COMMISSION OF CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.


CRUZ
RIVER
HIGHWAY



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M 2.50 MILES ABOVE MOUTH

2 CROSS SECTION

400 GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 5 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY 1968

BASE TOPOGRAPHIC MAPS FURNISHED BY STOLL AND BARR ENGINEERING CO.

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

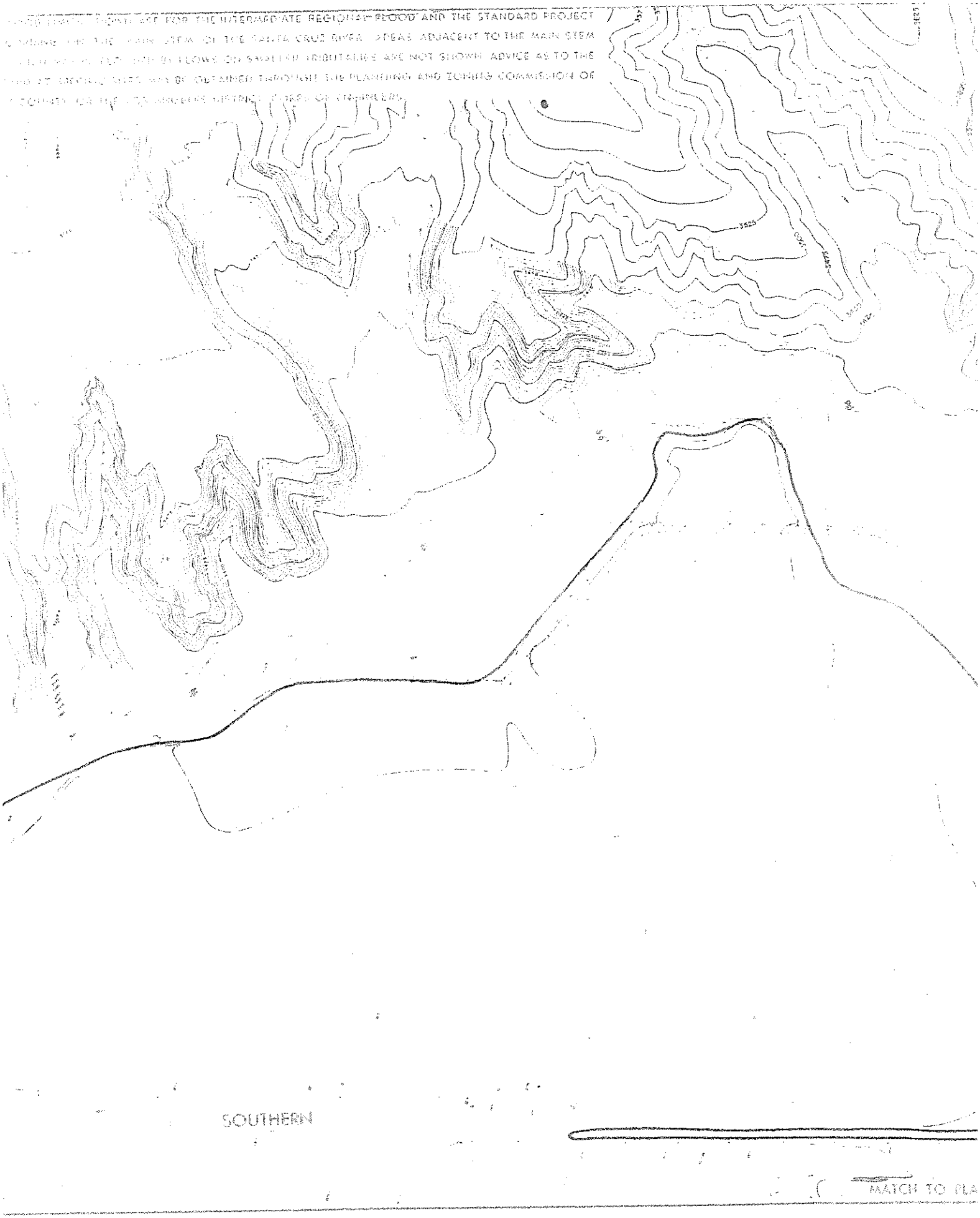
SANTA CRUZ COUNTY, ARIZONA

400 0 400

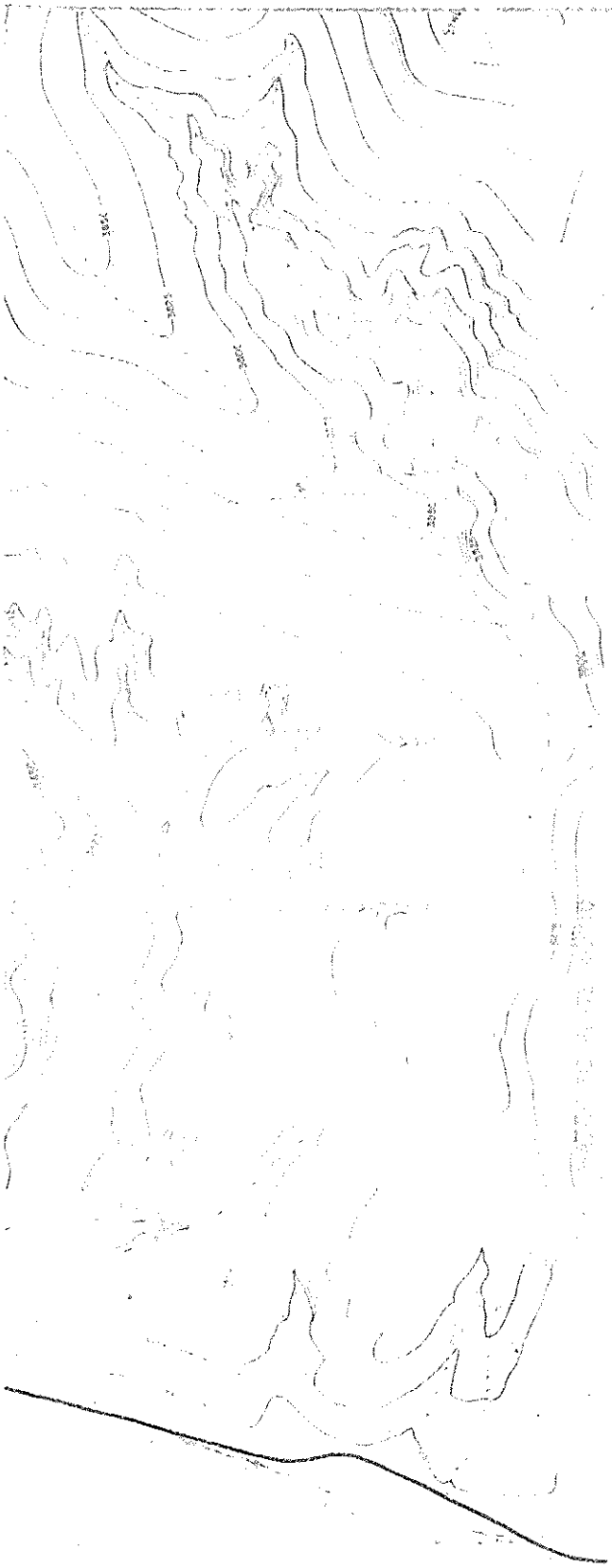
SCALE FEET

NOVEMBER 1969

PLATE 2


SOUTHERN
MATCH TO PLA


PACIFIC
RAILROAD
MATCH TO PLATE NO. 7



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA

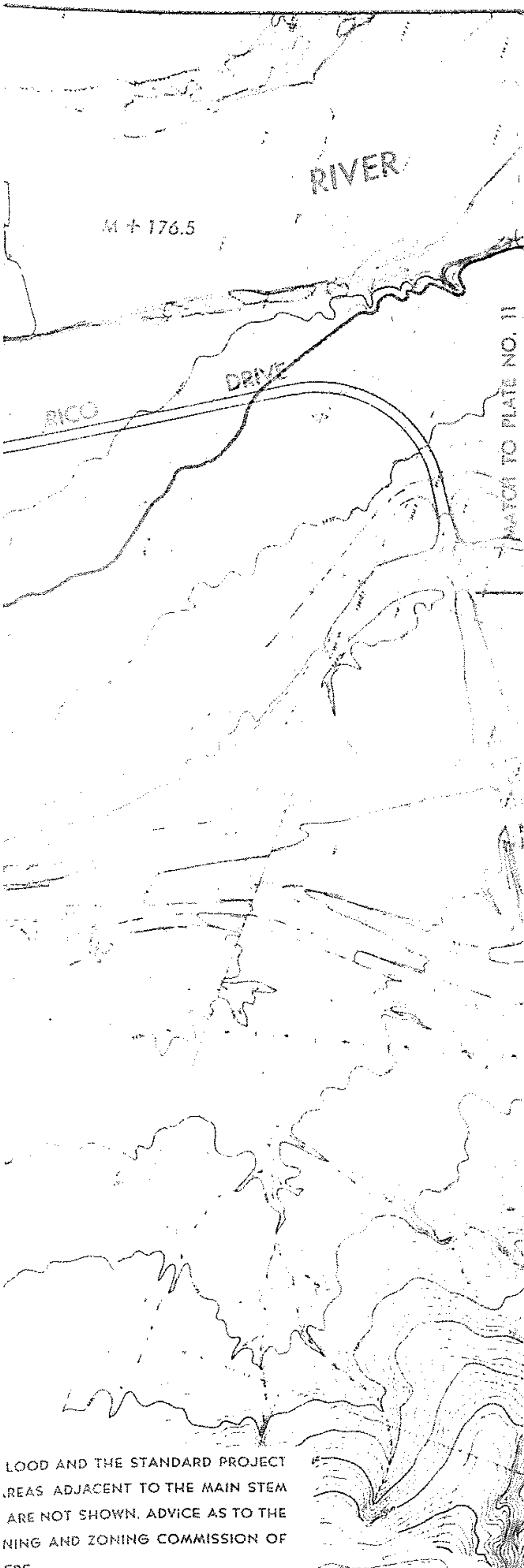
RAILROAD

SCALE 400 0 400 FEET

NOVEMBER 1969


M + 1755
SANTA
FLOW
M + 176
NOGALES-TUCSON
Agua
Fria
Canyon

NOTE - FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT FLOOD OCCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER. AREAS ADJACENT TO THE MAIN STEM FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING COMMISSION OF SANTA CRUZ COUNTY OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.



...LOOD AND THE STANDARD PROJECT
...REAS ADJACENT TO THE MAIN STEM
... ARE NOT SHOWN. ADVICE AS TO THE
...NING AND ZONING COMMISSION OF
...ERS.

LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M + 2.50 — MILES ABOVE MOUTH

2 — CROSS SECTION

400 — GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL [illegible]

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY: [illegible]

BASE TOPOGRAPHIC MAPS FURNISHED BY [illegible] AND RAPP [illegible]

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA

SCALE 400 0 400 FEET

NOVEMBER 1969


SOUTHERN


DRIVE
RICO
RICO
RAILROAD
PACIFIC
MATCH TO PLATE NO. 9

LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M+ 2.50 — MILES ABOVE MOUTH

CROSS SECTION

GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

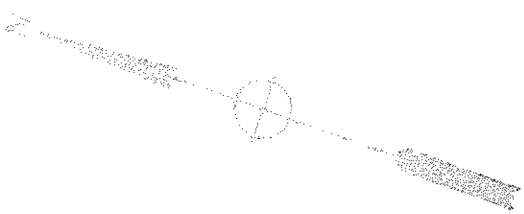
CONTOUR INTERVAL 2 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY [illegible]

BASE TOPOGRAPHIC MAPS FURNISHED BY [illegible] ENGINEERING CO.



CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

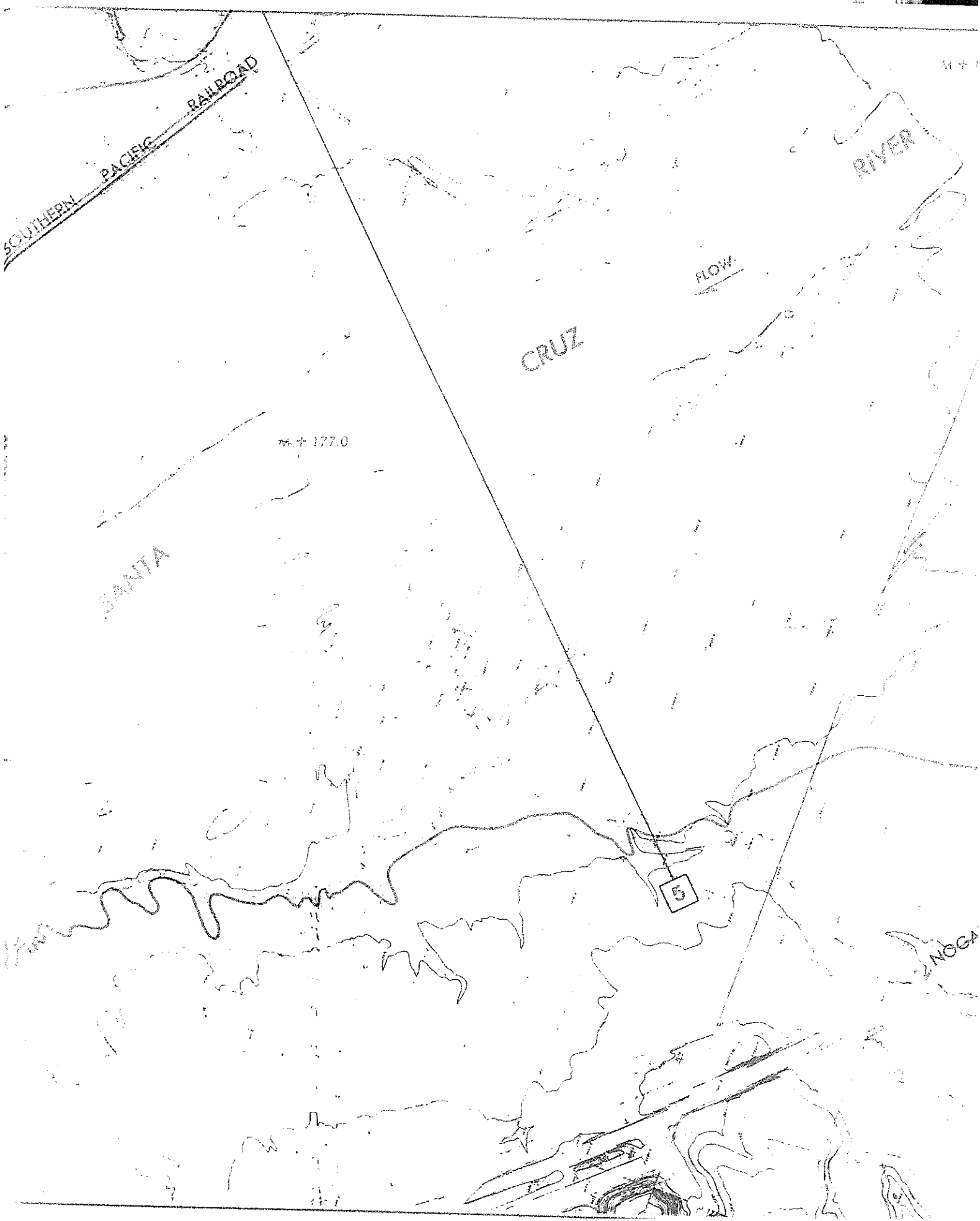
SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA

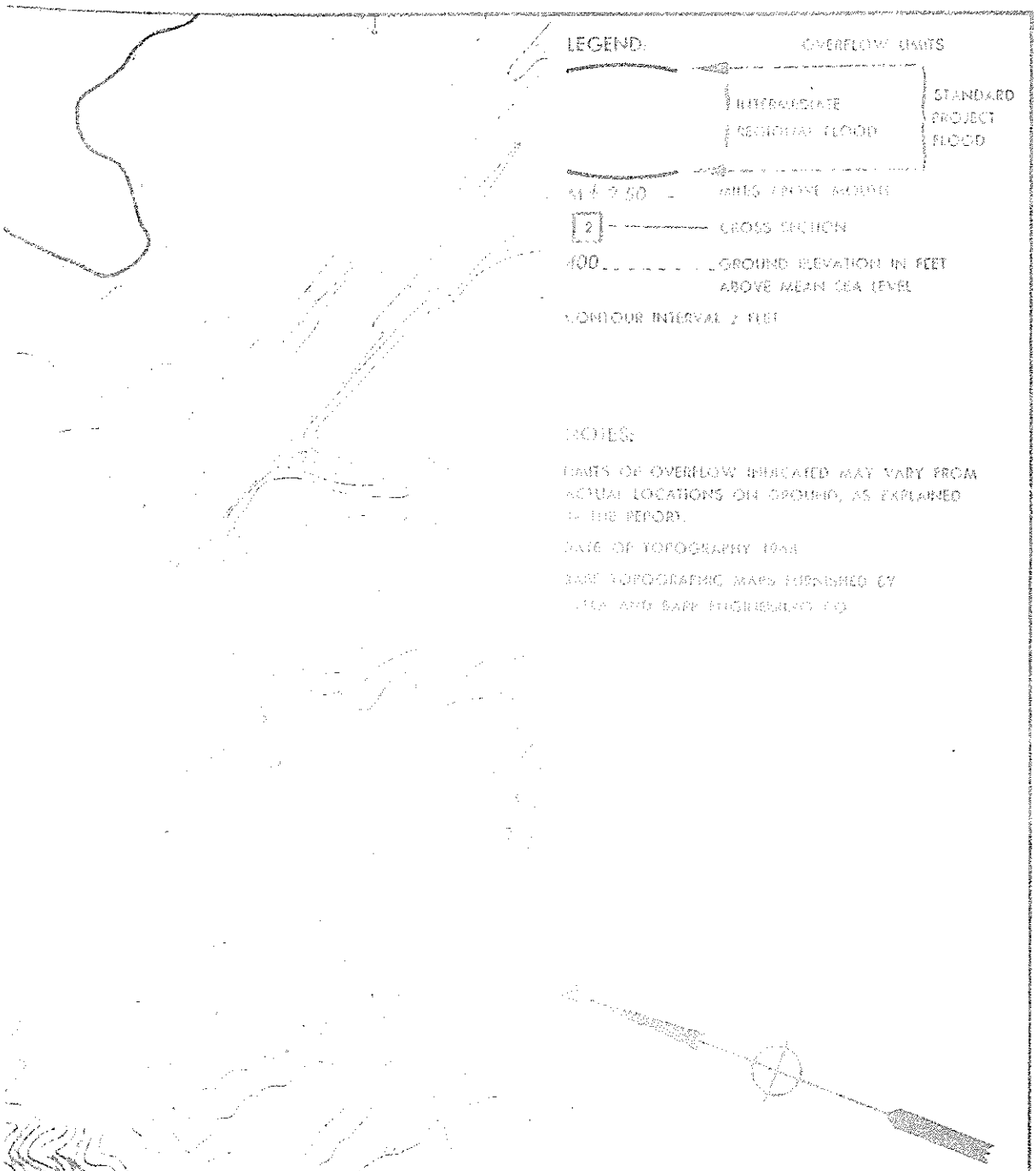
SCALE 400 0 400 FEET

NOVEMBER 1969

PLATE 10


SOUTHERN PACIFIC RAILROAD
RIVER
FLOW
CRUZ
M.P. 177.0
SANTA
5

NOTE: FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT FLOOD OCCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER AND SONOITA CREEK. AREAS ADJACENT TO THE MAIN STEM FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING COMMISSION OF SANTA CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

MILES FROM MOUTH

CROSS SECTION

GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 2 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY 1968

BASE TOPOGRAPHIC MAPS FURNISHED BY USGS AND SAFE ENGINEERING CO.

OOD AND THE STANDARD PROJECT
ADENA CREEK. AREAS ADJACENT TO
CR TRIBUTARIES ARE NOT SHOWN.
OUGH THE PLANNING AND ZONING
RPS OF ENGINEERS.

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA

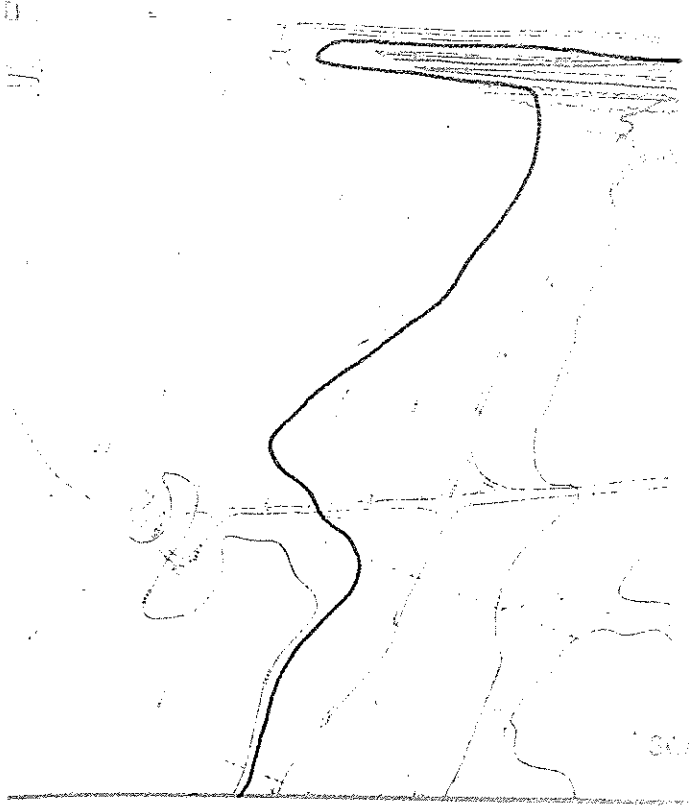
SCALE 400 0 400 FEET

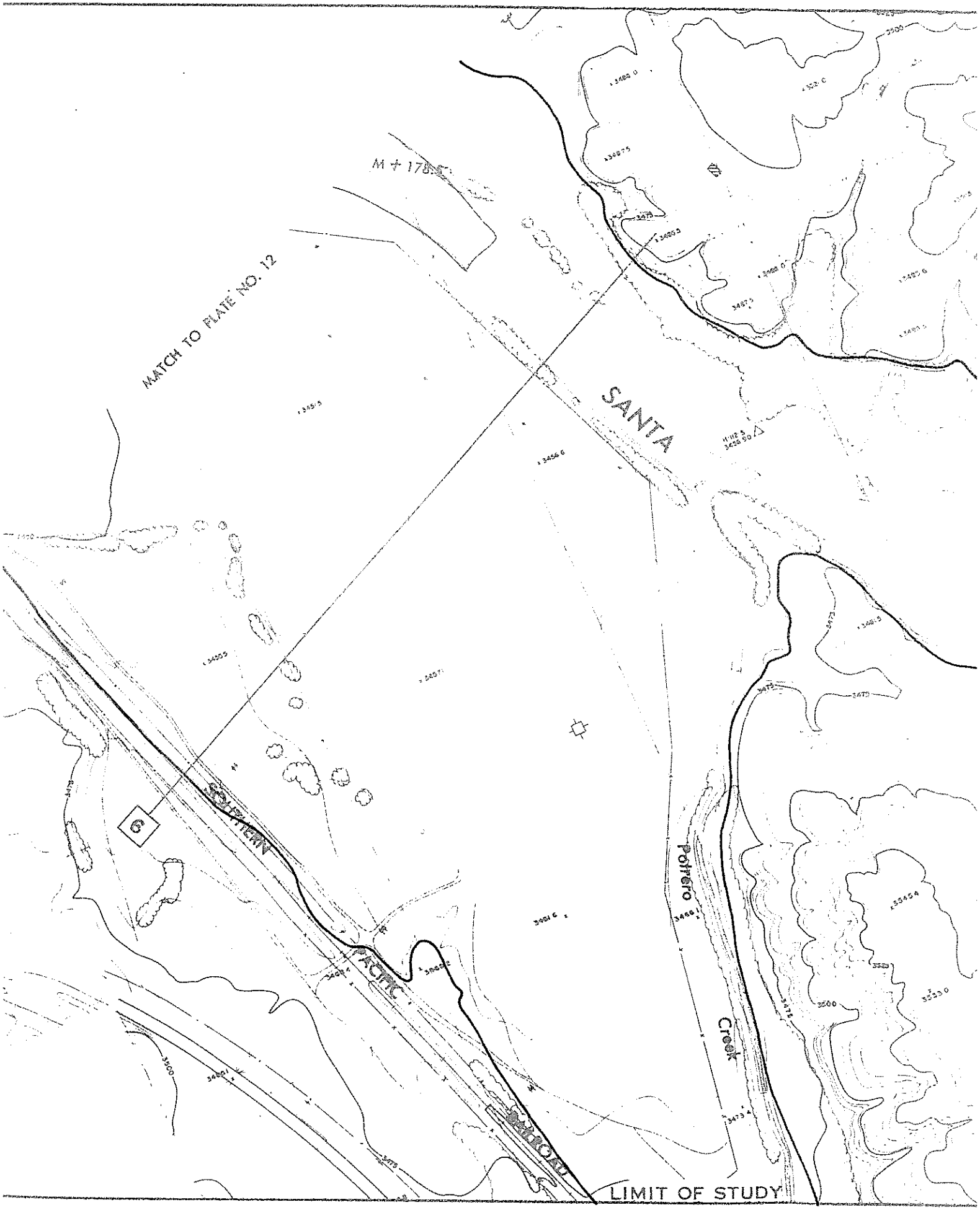
NOVEMBER 1969

FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT
CCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER AND SONOITA CREEK. AREAS ADJACENT TO
STEM, FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN.
S TO THE FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING
ION OF SANTA CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS

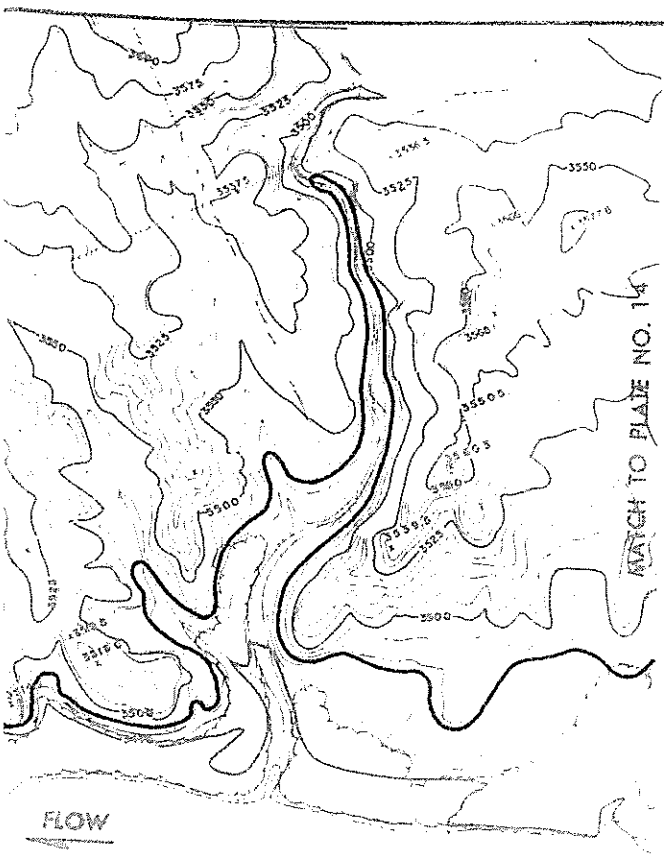
MATCH TO PLATE NO. 11


RIVER




MATCH TO PLATE NO. 12
SANTA
SOUTHERN
PACIFIC
RAILROAD
Potrero
Creek
LIMIT OF STUDY


FLOW
CRUZ
NOTE: FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STA
FLOOD OCCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER. AREAS ADJACENT TO
FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN. A
FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING
SANTA CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.



LEGEND:

OVERFLOW LIMITS

{ INTERMEDIATE REGIONAL FLOOD } STANDARD PROJECT FLOOD

M+ 2.50 ---- MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 ---------- GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

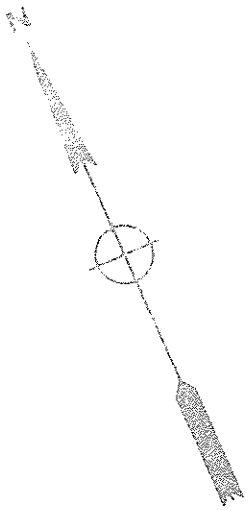
CONTOUR INTERVAL 5 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY 1968

BASE TOPOGRAPHIC MAPS FURNISHED BY CELLA AND BARR ENGINEERING CO.



...TE REGIONAL FLOOD AND THE STANDARD PROJECT
... CRUZ RIVER. AREAS ADJACENT TO THE MAIN STEM
...ER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE
...UGH THE PLANNING AND ZONING COMMISSION OF
...RPS OF ENGINEERS.

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

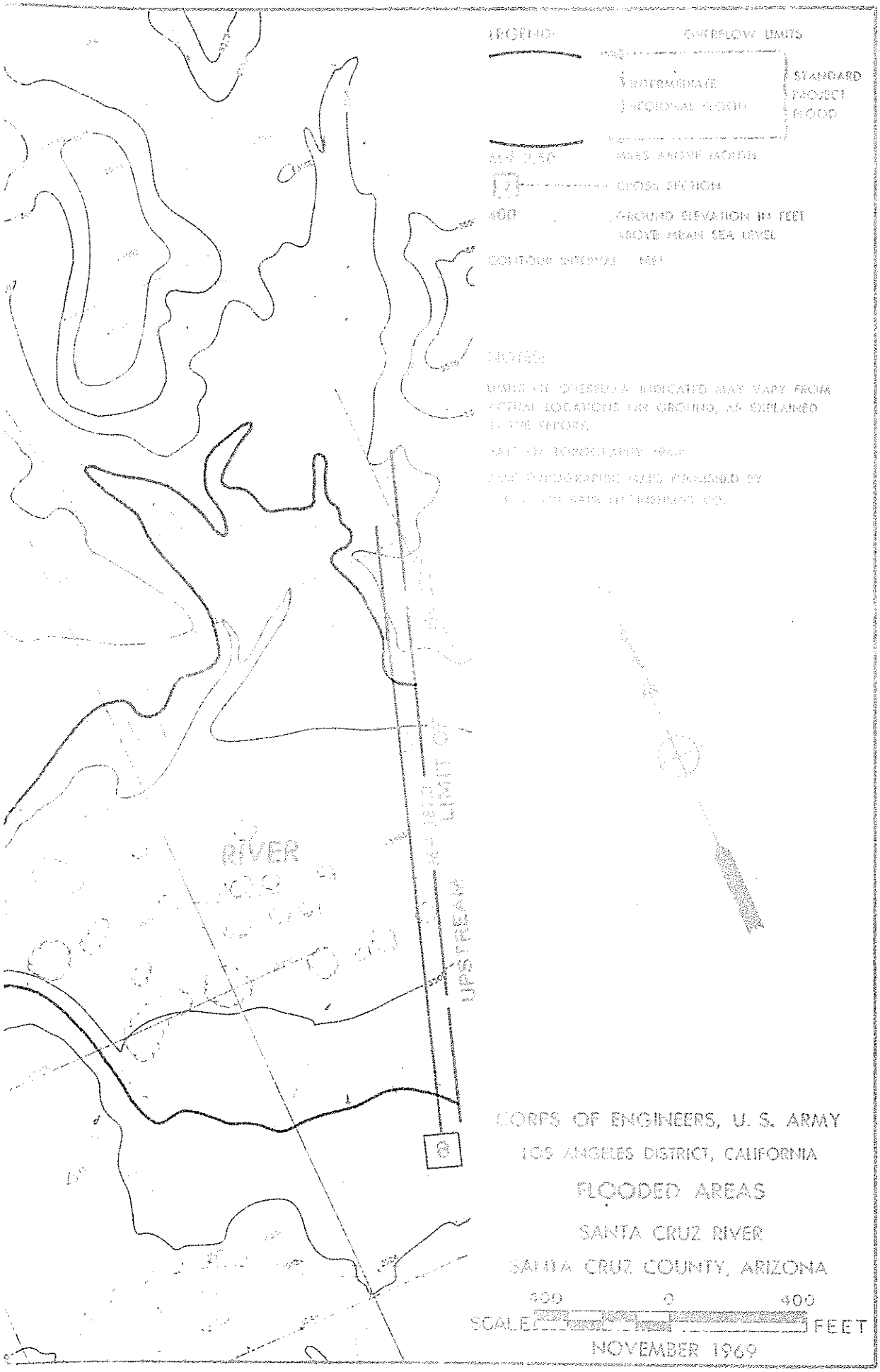
SANTA CRUZ COUNTY, ARIZONA

400 0 400

SCALE FEET

NOVEMBER 1969

NOTE: FLOOD LIMITS SHOWN ARE FOR THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT FLOOD OCCURRING ON THE MAIN STEM OF THE SANTA CRUZ RIVER. AREAS ADJACENT TO THE MAIN STEM FLOODWAY WHICH MAY BE FLOODED BY FLOWS ON SMALLER TRIBUTARIES ARE NOT SHOWN. ADVICE AS TO THE FLOOD HAZARD AT SPECIFIC SITES MAY BE OBTAINED THROUGH THE PLANNING AND ZONING COMMISSION OF SANTA CRUZ COUNTY, OR THE LOS ANGELES DISTRICT, CORPS OF ENGINEERS.



CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS

SANTA CRUZ RIVER

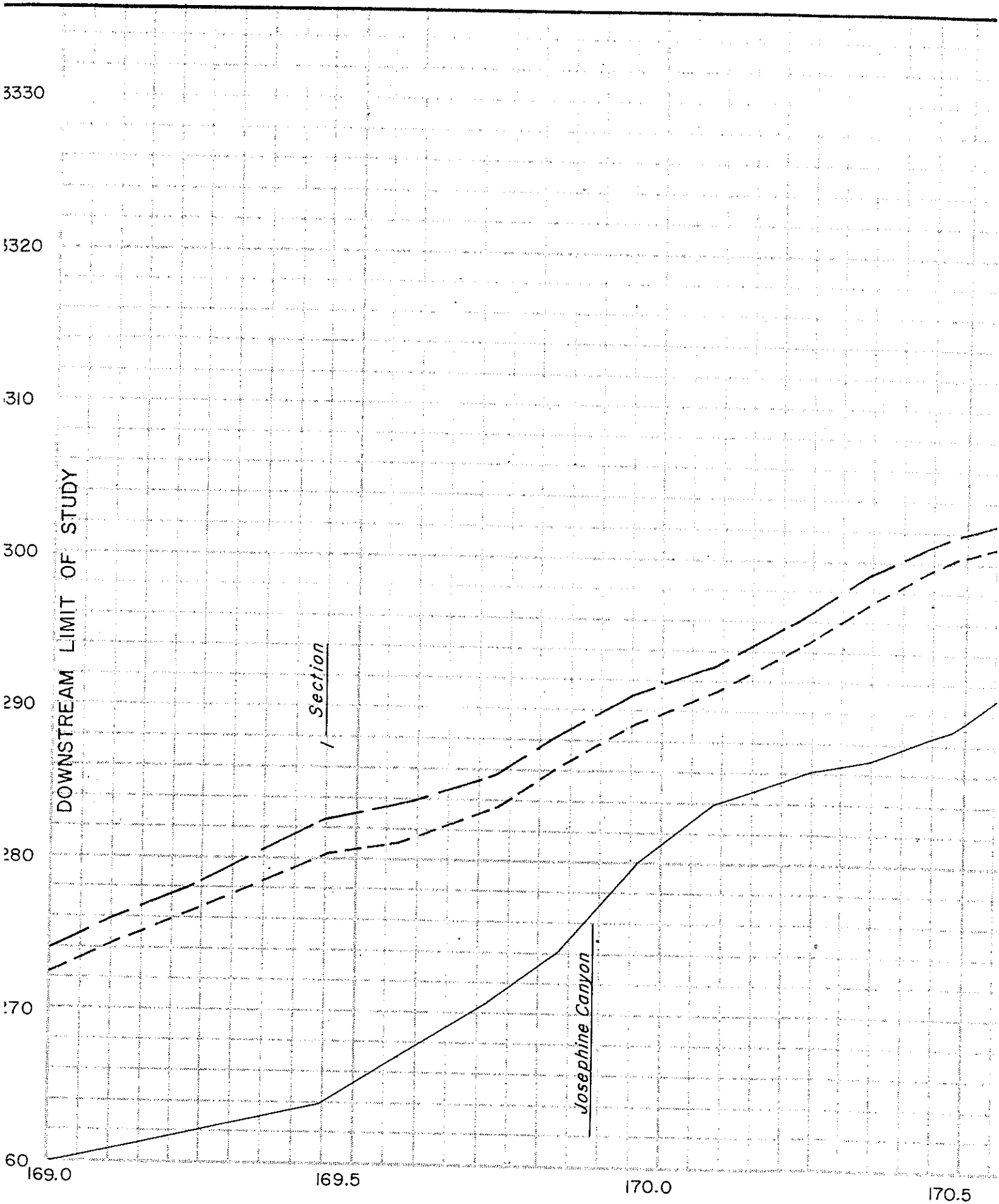
SANTA CRUZ COUNTY, ARIZONA

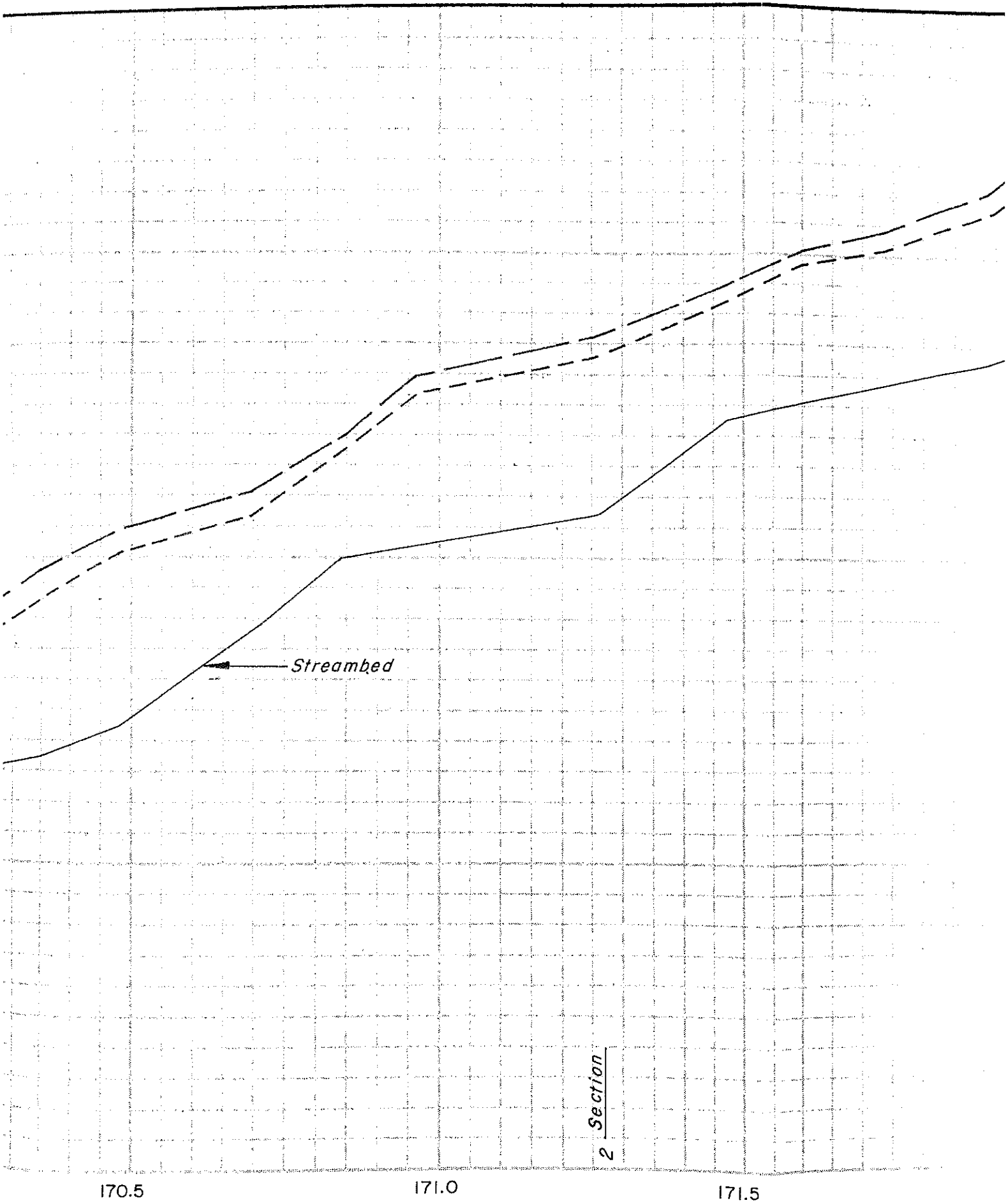
400 0 400

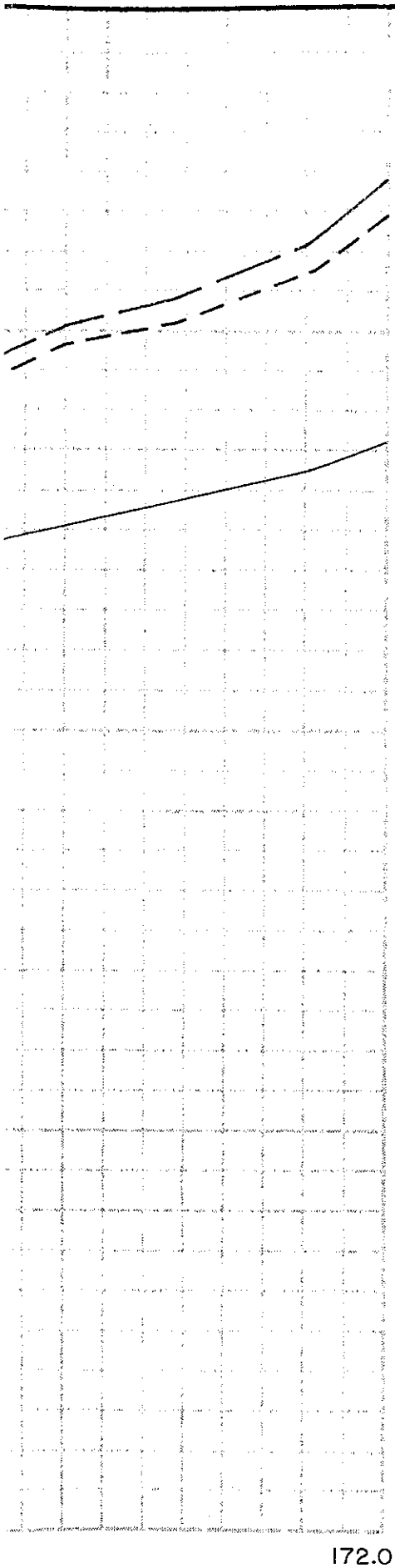
SCALE FEET

NOVEMBER 1969

PLATE 14


3330
3320
3310
3300
3290
3280
3270
3260
DOWNSTREAM LIMIT OF STUDY
Section
Josephine Canyon
169.0
169.5
170.0
170.5
DISTANCE IN


Streambed
2 Section
170.5
171.0
171.5
DISTANCE IN MILES ABOVE MOUTH



LEGEND

Standard Project Flood ———— ———— ————

Intermediate Regional Flood — — — — — —

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

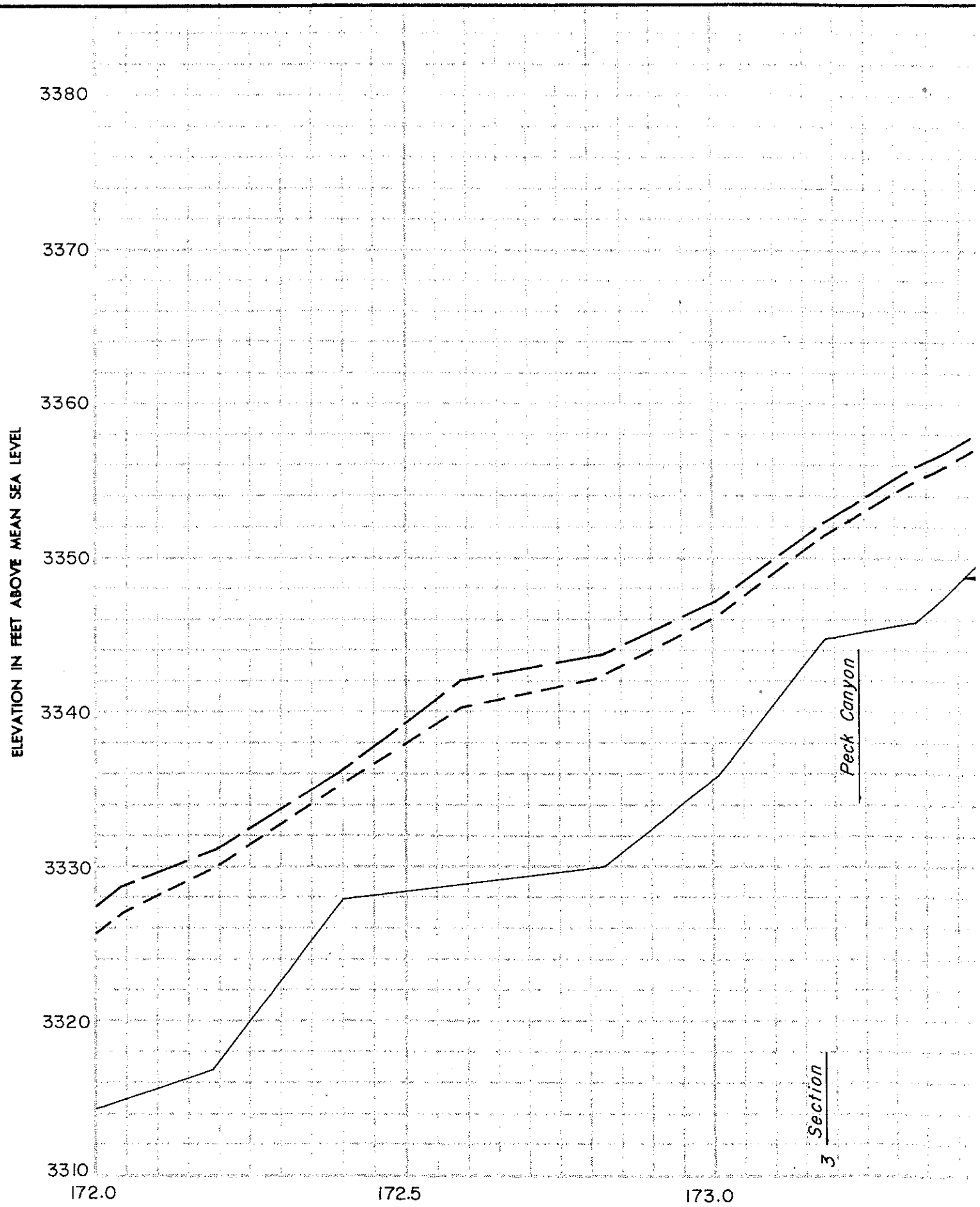
HIGH WATER PROFILES

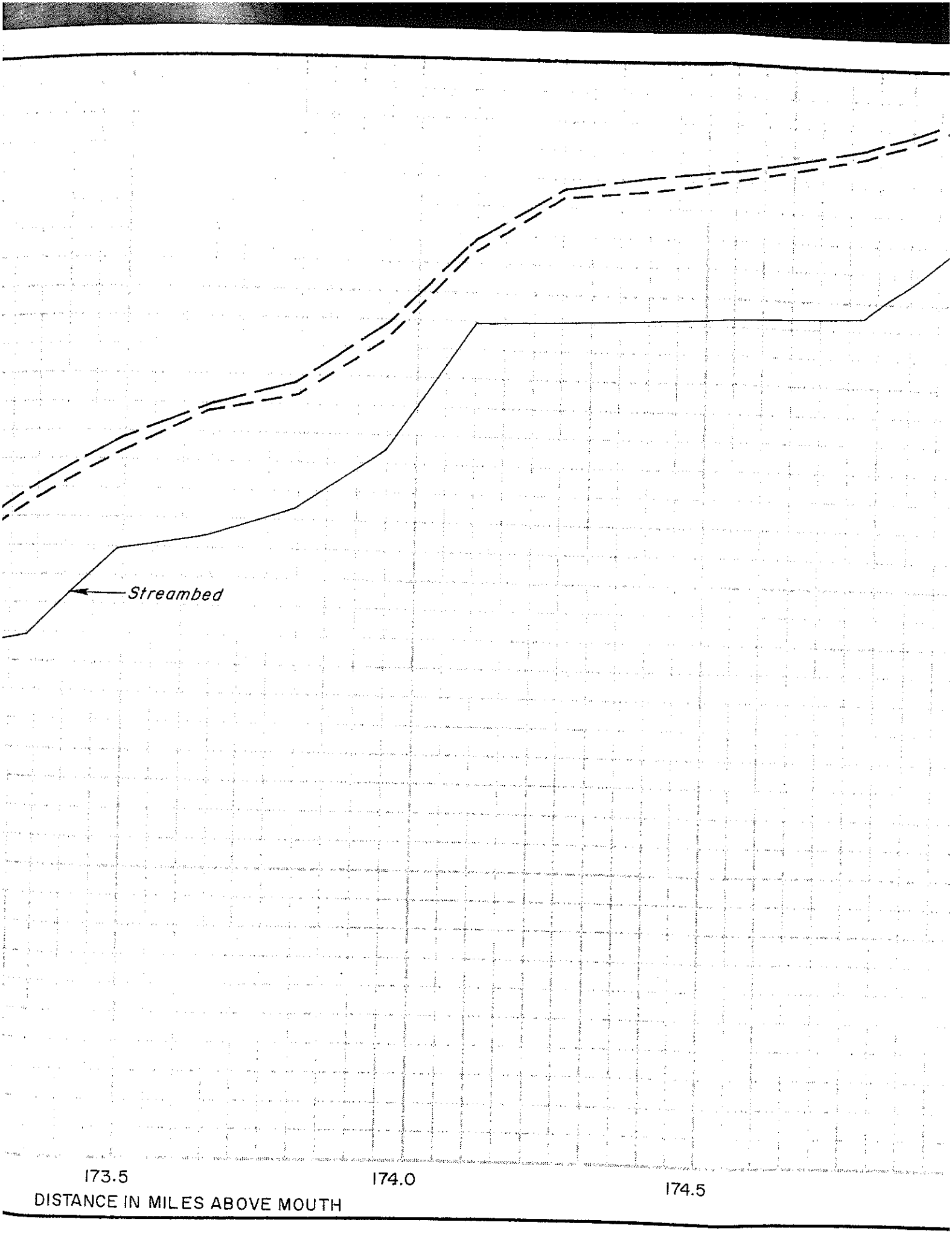
SANTA CRUZ RIVER

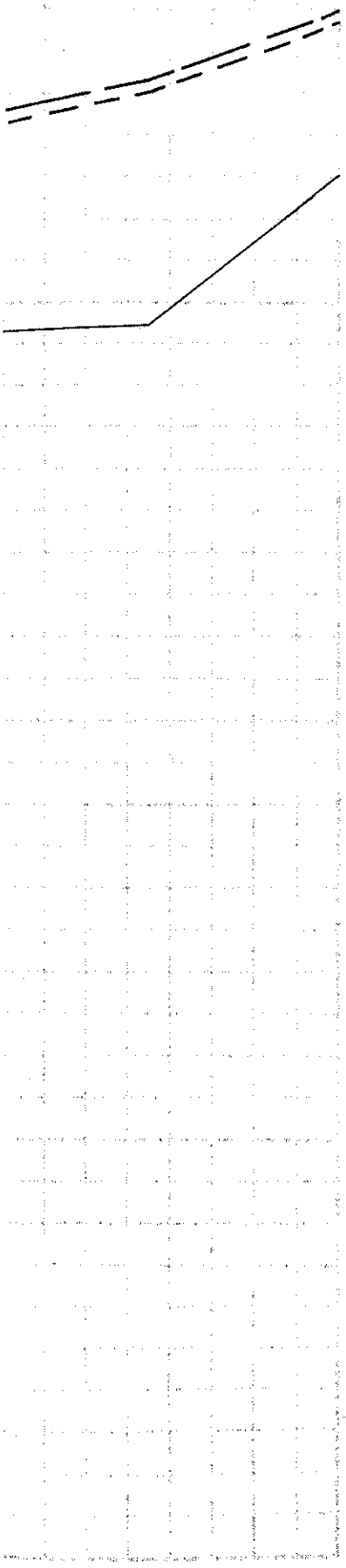
SANTA CRUZ COUNTY, ARIZONA

NOVEMBER 1969

PLATE 15


3380
3370
3360
3350
3340
3330
3320
3310
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
172.0
172.5
173.0
DIST
Peck Canyon
3 Section


Streambed
173.5
174.0
174.5
DISTANCE IN MILES ABOVE MOUTH



LEGEND

Standard Project Flood _____ _____ _____

Intermediate Regional Flood _ _ _ _ _ _

NOTE:

HIGH WATER PROFILES INDICATE THE WATER SURFACE ELEVATIONS OF THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT FLOOD IN THE MAIN STEM OF THE SANTA CRUZ RIVER. IN SOME REACHES WHERE THE SOUTHERN PACIFIC RAILROAD ACTS AS A LEVEE, FLOWS EAST OF THE RAILROAD WOULD BE AT DIFFERENT STAGES THAN FLOWS IN THE MAIN STEM OF THE SANTA CRUZ RIVER, AS INDICATED BY THE CROSS SECTIONS.

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

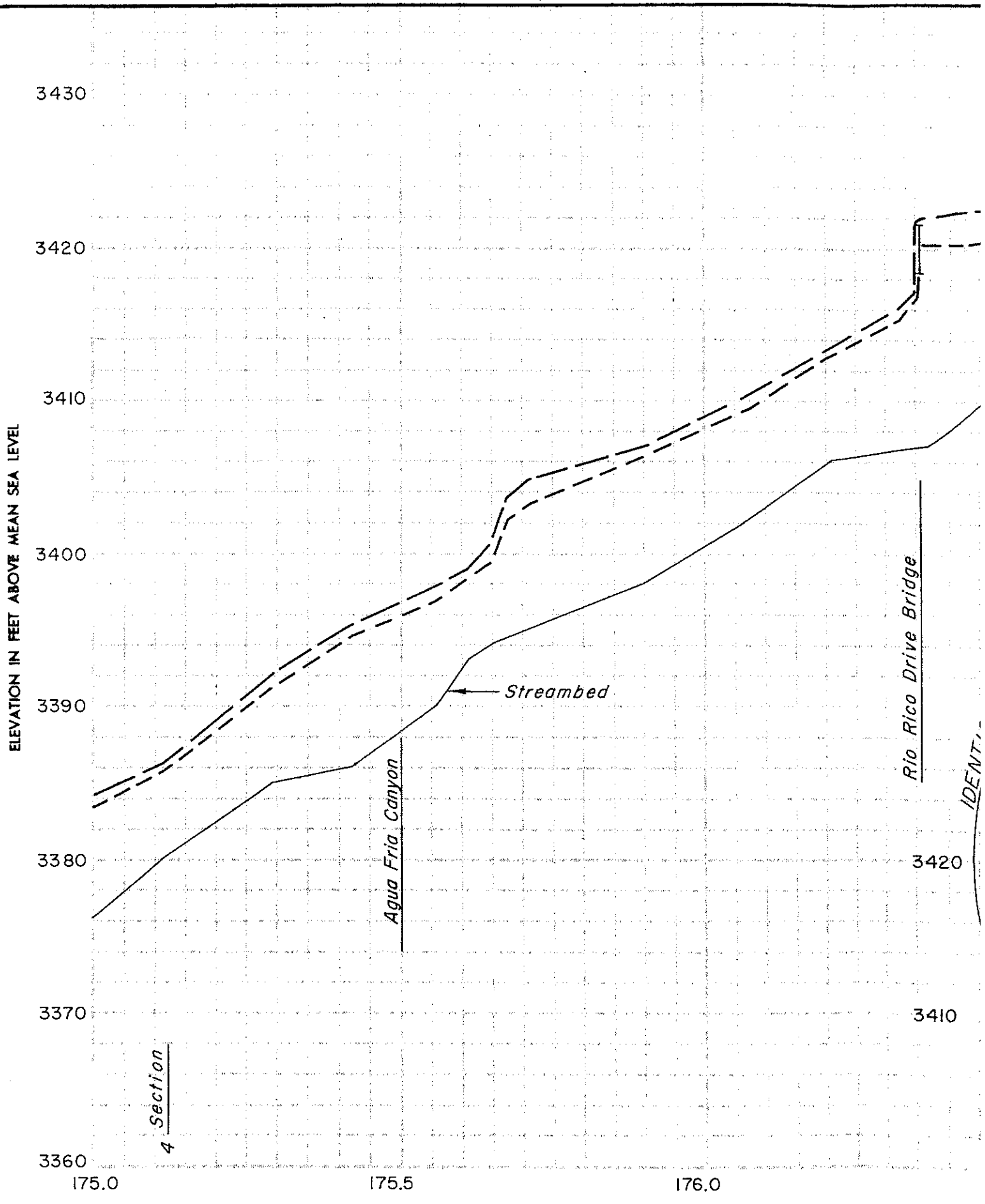
HIGH WATER PROFILES

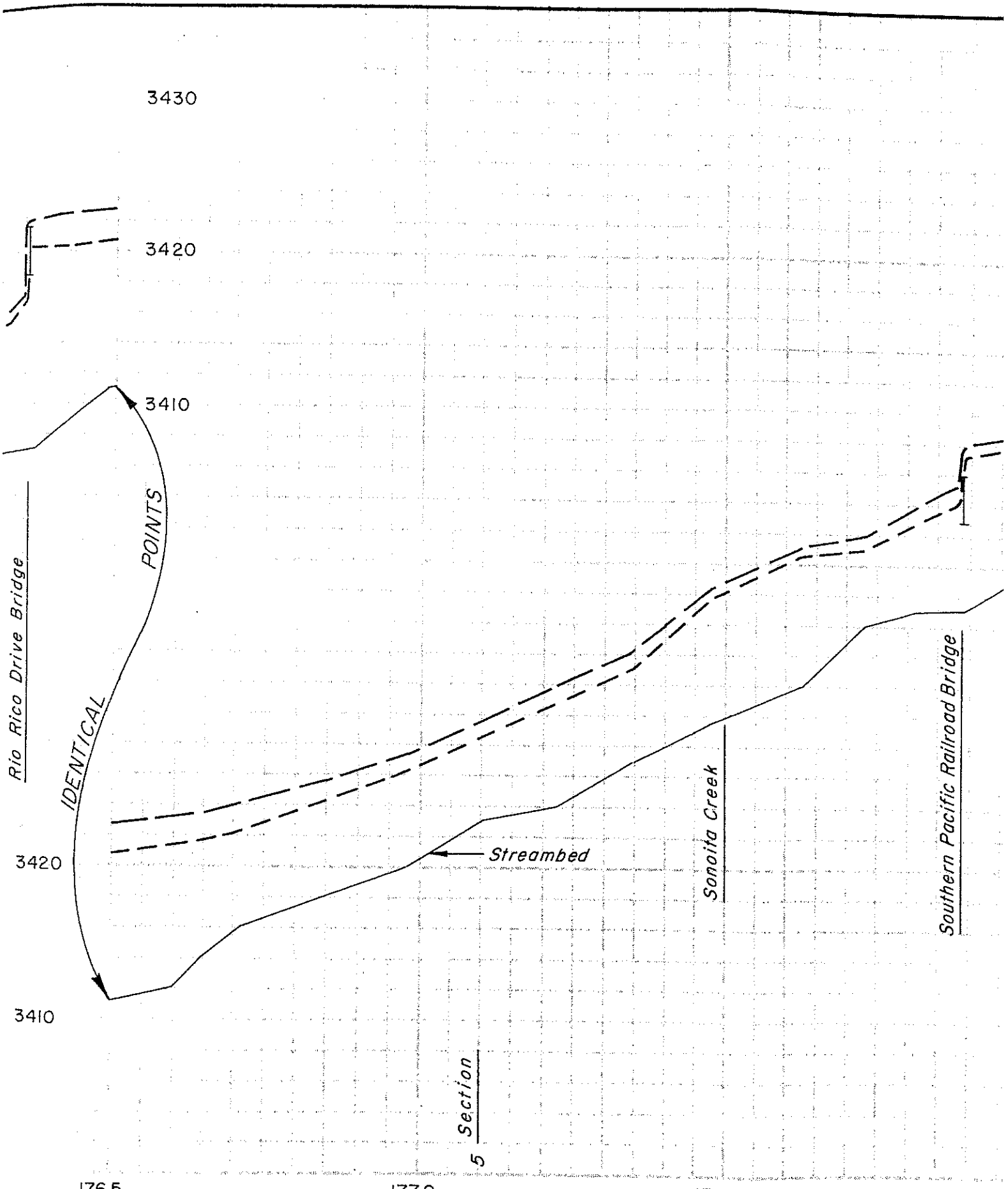
SANTA CRUZ RIVER

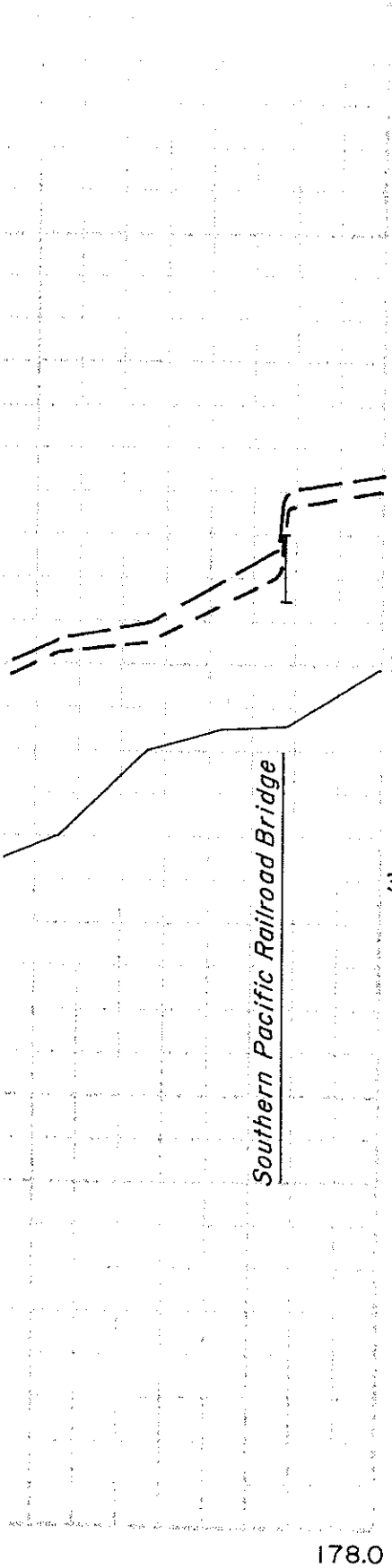
SANTA CRUZ COUNTY, ARIZONA

NOVEMBER 1969

PLATE 16


3430
3420
3410
3400
3390
3380
3370
3360
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
Streambed
Agua Fria Canyon
Rio Rico Drive Bridge
3420
3410
Section 4
175.0
175.5
176.0
DISTA


3430
3420
3410
POINTS
IDENTICAL
Rio Rico Drive Bridge
3420
3410
Streambed
Sonoita Creek
Southern Pacific Railroad Bridge
Section 5
176.5
177.0
177.5
17
DISTANCE IN MILES ABOVE MOUTH



LEGEND

Standard Project Flood ——— ——— ———

Intermediate Regional Flood — — — — — —

NOTE:

HIGH WATER PROFILES INDICATE THE WATER SURFACE ELEVATIONS OF THE INTERMEDIATE REGIONAL FLOOD AND THE STANDARD PROJECT FLOOD IN THE MAIN STEM OF THE SANTA CRUZ RIVER. IN SOME REACHES WHERE THE SOUTHERN PACIFIC RAILROAD ACTS AS A LEVEE, FLOWS EAST OF THE RAILROAD WOULD BE AT DIFFERENT STAGES THAN FLOWS IN THE MAIN STEM OF THE SANTA CRUZ RIVER, AS INDICATED BY THE CROSS SECTIONS.

CORPS OF ENGINEEPS, U. S. ARMY

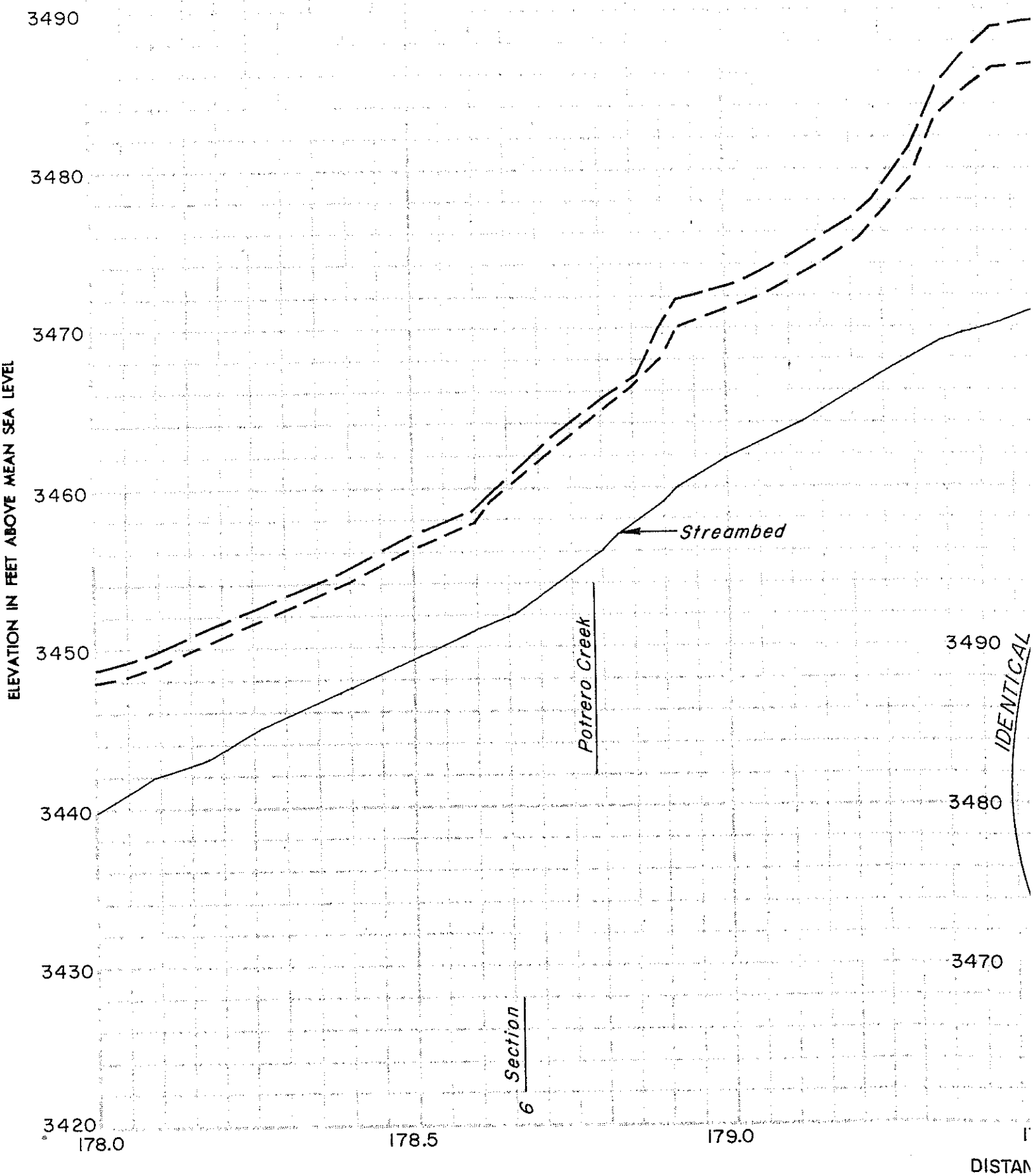
LOS ANGELES DISTRICT, CALIFORNIA

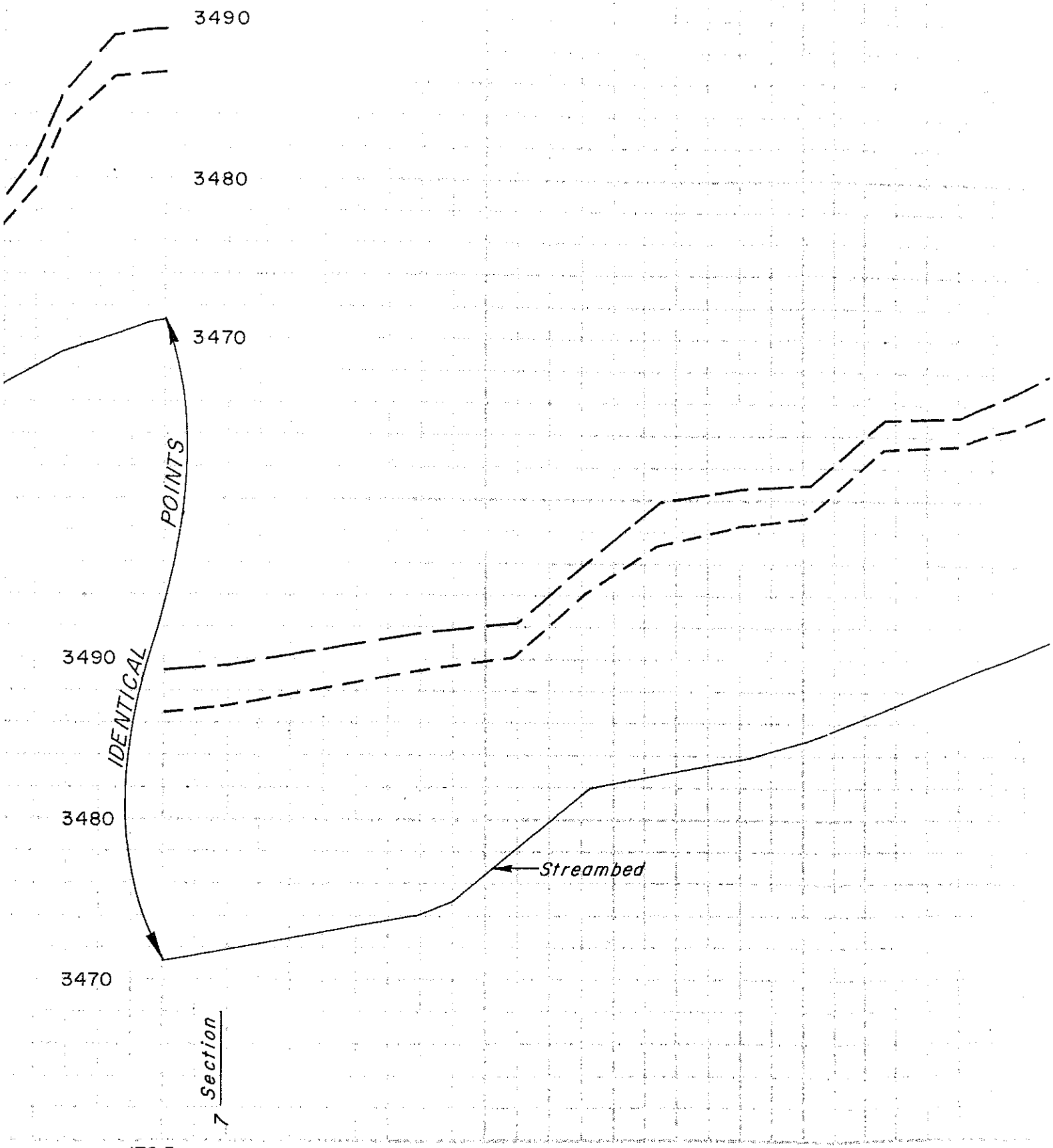
HIGH WATER PROFILES

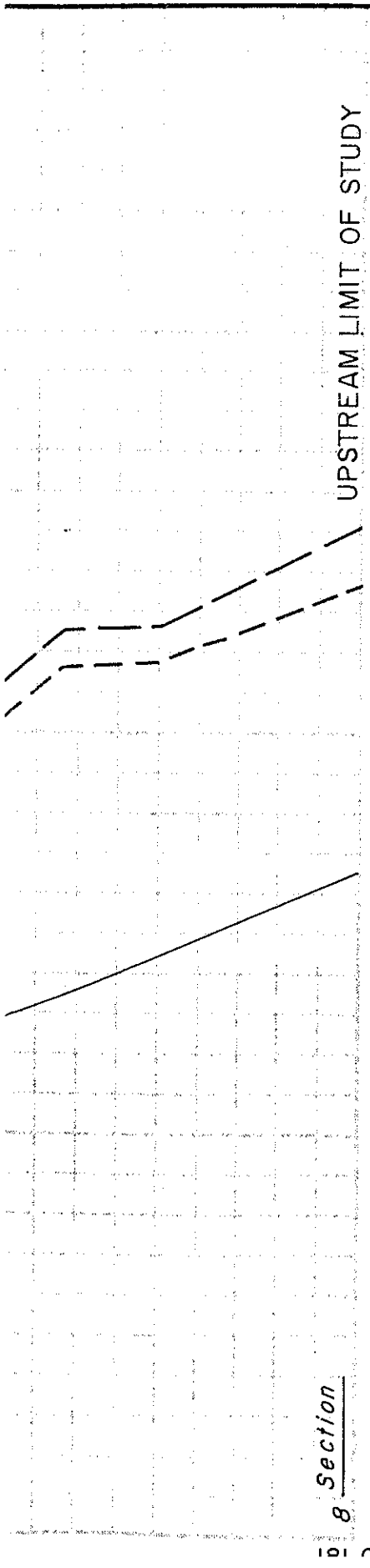
SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA

NOVEMBER 1969


3490
3480
3470
3460
3450
3440
3430
3420
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
Streambed
Potrero Creek
Section 6
178.0
178.5
179.0
3490
3480
3470
IDENTICAL
DISTAN


3490
3480
3470
POINTS
IDENTICAL
3490
3480
3470
Streambed
Section 7
179.5
180.0
180.5
DISTANCE IN MILES ABOVE MOUTH



LEGEND

Standard Project Flood ——— ——— ———

Intermediate Regional Flood — — — — —

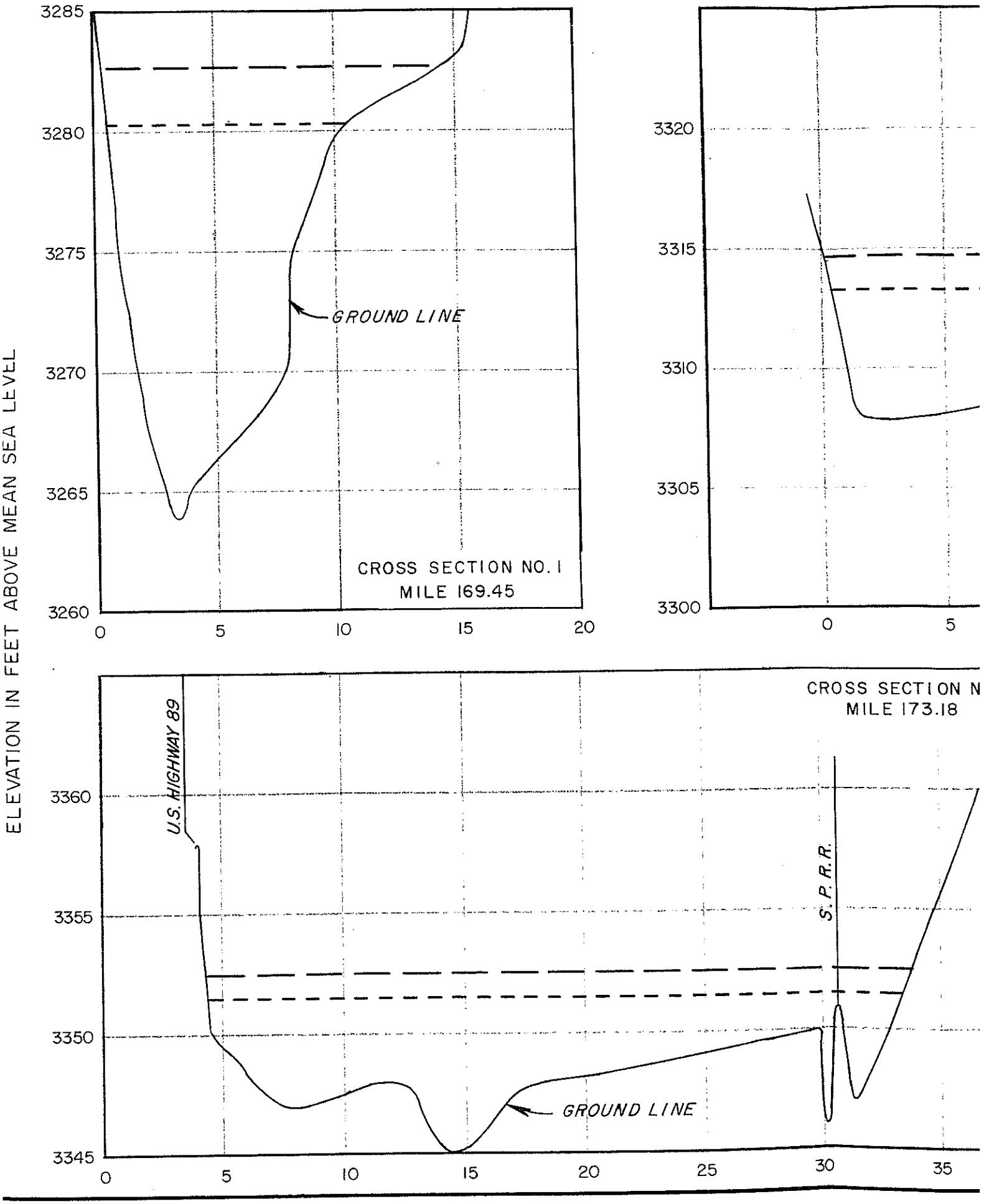
CORPS OF ENGINEERS, U. S. ARMY

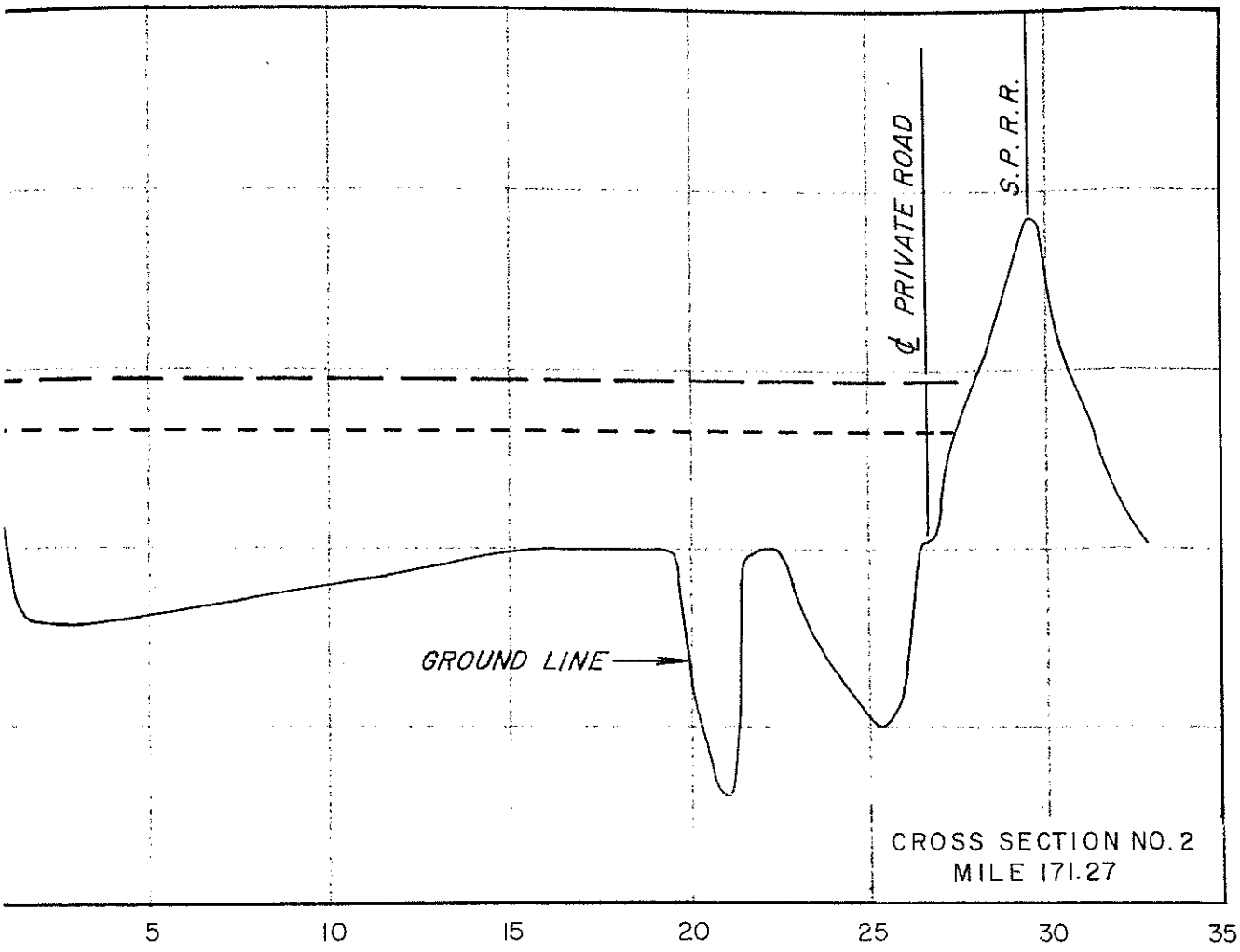
LOS ANGELES DISTRICT, CALIFORNIA

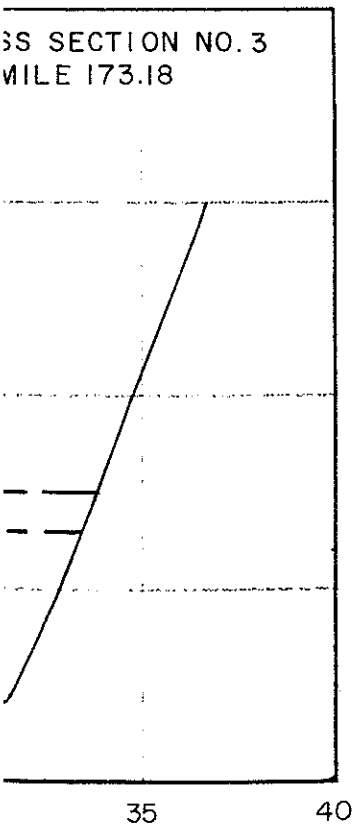
HIGH WATER PROFILES

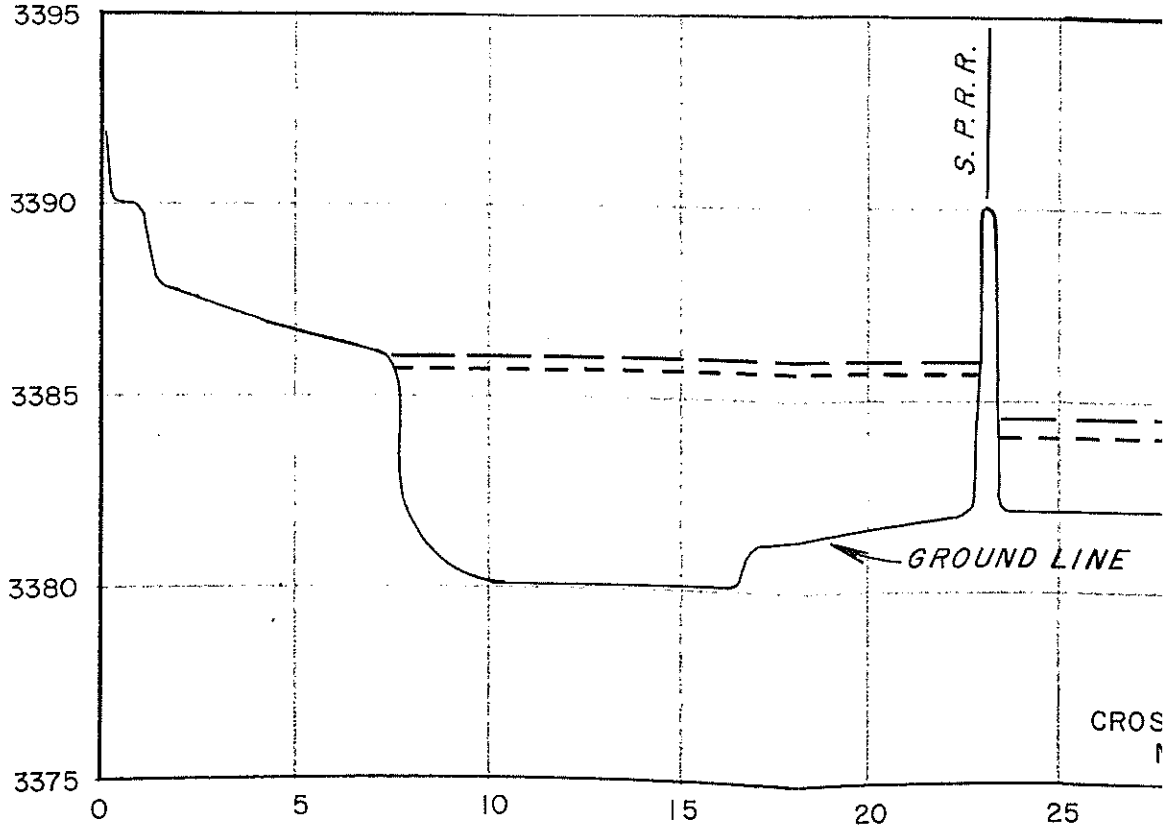
SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
3285
3280
3275
3270
3265
3260
GROUND LINE
CROSS SECTION NO. 1
MILE 169.45
0
5
10
15
20
3320
3315
3310
3305
3300
0
5
CROSS SECTION N
MILE 173.18
U.S. HIGHWAY 89
S.P.R.R.
3360
3355
3350
3345
GROUND LINE
0
5
10
15
20
25
30
35


℄ PRIVATE ROAD
S.P.R.R.
GROUND LINE
CROSS SECTION NO. 2
MILE 171.27
5
10
15
20
25
30
35


SS SECTION NO. 3
MILE 173.18
35
40


3395
3390
3385
3380
3375
S.P.R.R.
GROUND LINE
CROS
0
5
10
15
20
25

LEGEND

——— ——— Standard Project Flood.

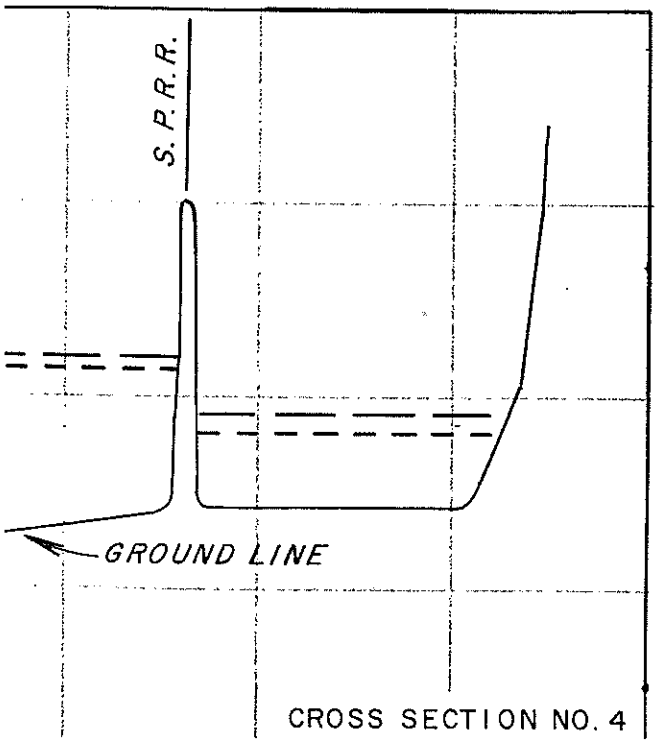
– – – – – – – Intermediate Regional Flood.

NOTE:

Horizontal distance in hundred feet.
Sections taken looking downstream.

NO. 2

35

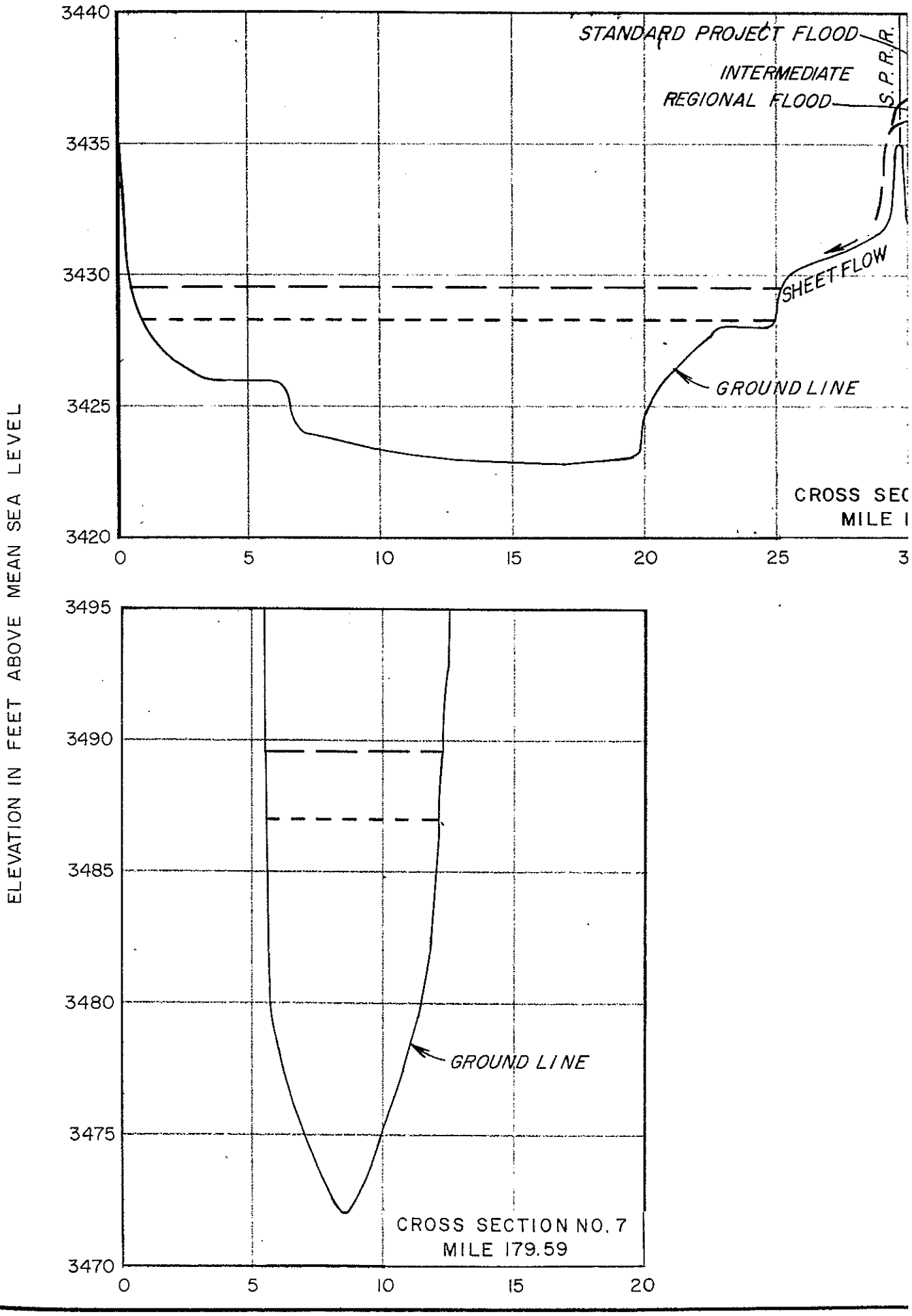


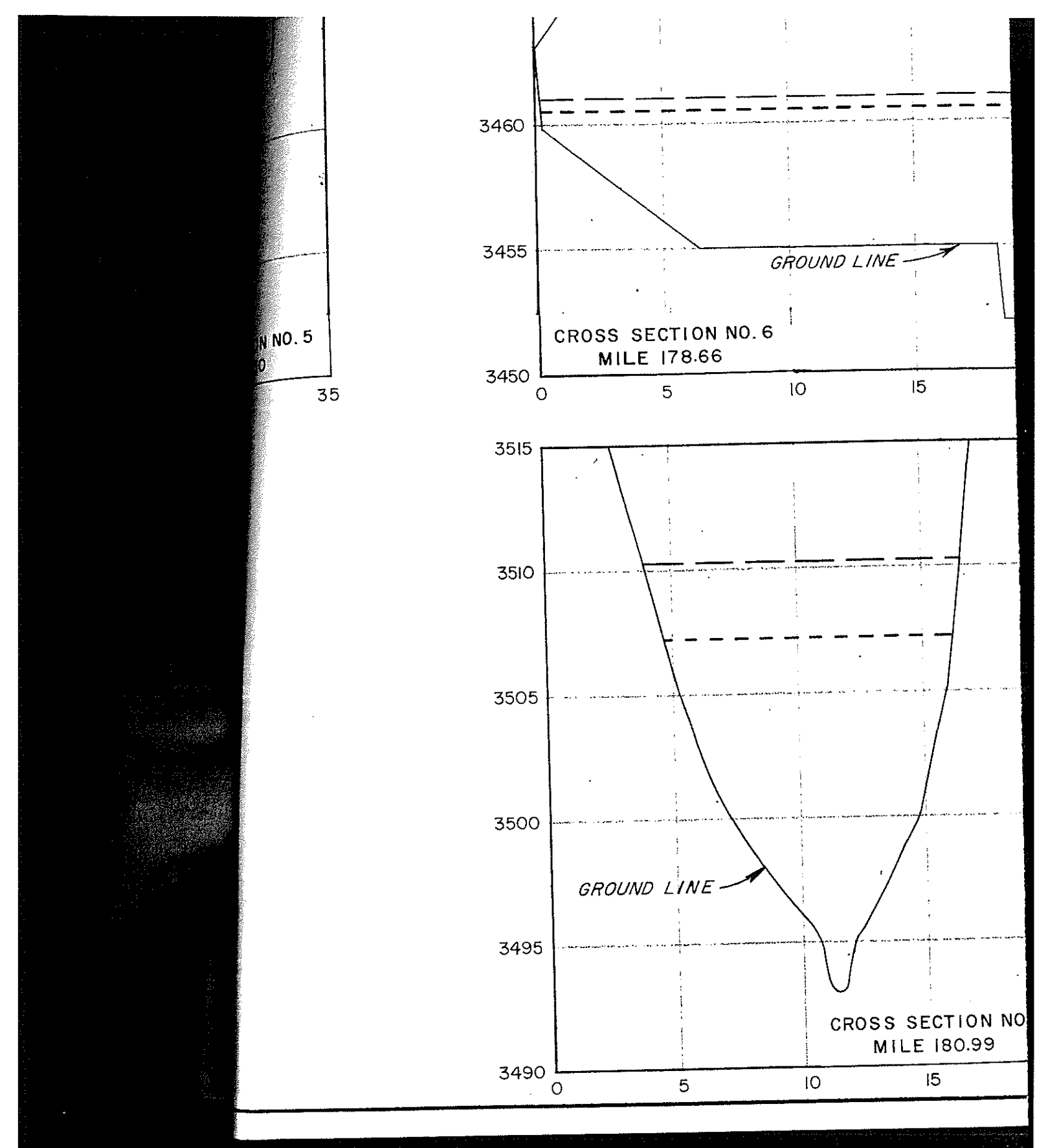
CROSS SECTION NO. 4

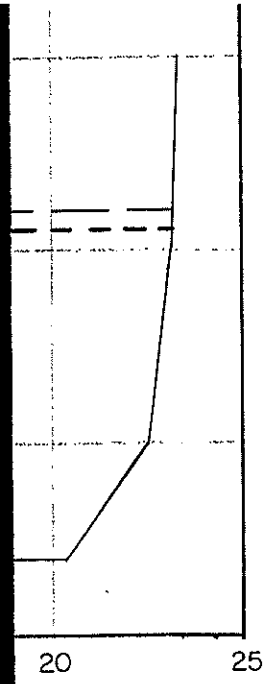
CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA

CROSS SECTIONS

SANTA CRUZ RIVER
SANTA CRUZ COUNTY, ARIZONA


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
3440
3435
3430
3425
3420
0
5
10
15
20
25
STANDARD PROJECT FLOOD
INTERMEDIATE REGIONAL FLOOD
S.P.R.R.
SHEET FLOW
GROUND LINE
CROSS SEC
MILE
3495
3490
3485
3480
3475
3470
0
5
10
15
20
GROUND LINE
CROSS SECTION NO. 7
MILE 179.59


N NO. 5
0
35
3460
3455
3450
GROUND LINE
CROSS SECTION NO. 6
MILE 178.66
0
5
10
15
3515
3510
3505
3500
3495
3490
GROUND LINE
CROSS SECTION NO
MILE 180.99
0
5
10
15



——— Standard Project Flood.

– – – – – – Intermediate Regional Flood.

NOTE :

Horizontal distance in hundred feet.
Sections taken looking downstream.

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

CROSS SECTIONS

SANTA CRUZ RIVER

SANTA CRUZ COUNTY, ARIZONA

NOVEMBER 1969

PLATE 20